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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES-- CHANGES IN PATIENT SEVERITY AND HOSPITAL UTILIZATION MEASURED WITH MEDISGRPS

Working Paper

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*Judith Lavor Williams was instrumental in designing this project and working with MediQual Systems, Inc., in developing the data base. Larry Forgy did some initial work with the data.

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ABSTRACT

Controlling adequately for illness severity is a problem that plagues most studies of hospital utilization. This study uses Medisgrps data to measure severity at admission to and discharge from a hospital of Medicare admissions for pneumonia, stroke and hip replacement cases. The Medisgrps software codes severity into one of five categories based on key clinical findings from patient records. The relation between patient severity and various outcomes including death, readmission, and length of stay is analyzed. In addition, the paper examines changes between 1982 and 1985 in severity itself as well as in hospital length of stay, post-hospital mortality rates, and readmission rates. Since the years 1982 and 1985 span the introduction of Medicare's Prospective Payment System (PPS), any measured changes between the two years may be at least partly attributable to PPS.

The analysis suggests that admission severity, as measured by Medisgrps is correlated with outcome measures, particularly death. Moreover, average severity, particularly at admission, increased between 1982 and 1985; at the same time, lengths of stay have decreased; readmissions have increased, but no change has occurred in mortality rates for the disease categories studied.

key words: patient severity, PPS, lengths of stay, readmission rates, mortality rates, Medisgrps

ABSTRACT

Controlling adequately for illness severity is a problem that plagues most studies of hospital effectiveness. This study uses MedisGroups data to measure severity at admission in all discharges from a subsample of Medicare hospitals for pneumonia, stroke, and hip replacement cases. The MedisGroups system classifies severity into one of five categories (0 to 4) by abstracting findings from patients' records. The relation between patient severity and various outcomes including death, readmission, and length of stay is analyzed. In addition, the paper examines changes in severity and case mix in 1983-1985, as well as in hospital length of stay, post-hospital mortality rates and readmission rates. Since the years 1983 and 1985 span the introduction of Medicare's Prospective Payment System (PPS), any observed changes between the two years may be at least partly attributable to PPS.

The analysis suggests that admission severity, as measured by MedisGroups, is correlated with outcome measures, particularly death. Moreover, average severity, particularly at admission, increased between 1983 and 1985; at the same time, lengths of stay have decreased, readmissions have increased, but no change has occurred in mortality rates for the disease categories studied.

KEY WORDS: patient severity, PPS, lengths of stay, readmission rates, mortality rates, MedisGroups

I. Introduction

One of the problems plaguing most studies of medical providers and the care that they provide is the difficulty in controlling adequately for severity of illness. For example, simple hospital mortality rates tell us little about variations in quality of care across hospitals because more sophisticated hospitals are likely to attract a more complex casemix of sicker patients and thus have a higher mortality rate. In addition to being a research problem, the difficulty of holding constant patient severity complicates both quality of care assessment and the determination of appropriate payments to care providers. This study attempts to overcome the problem by using a data set that provides measures of severity at the time of admission to and discharge from the hospital for Medicare patients in two diagnoses (pneumonia and stroke) and one procedure (hip replacement.)

It is often alleged that since the implementation of PPS in late 1983, Medicare patients are being discharged "quicker and sicker," i.e. that length of stay has fallen and severity at discharge has risen. Another possible repercussion is an increase in readmission or mortality rates.

In addition, most people expected that admissions would increase under PPS. Since payment under PPS is made on a per-admission basis and depends only on which of 470 DRGs a patient is classified into, hospitals should have the incentive to minimize the amount of care provided during each stay and maximize the number of stays. Contrary to most people's initial expectations, however, admissions have fallen substantially since the advent of PPS. Admissions of the over-65 population, although increasing slightly during the last year, have dropped by over 8 percent since 1983.[1] The decline in admissions of the under-65 population has been even more dramatic. This implies that forces other than the expected PPS incentive may be exerting stronger pressure on hospital admission patterns. Since physicians play a leading role in determining admissions and discharges, if the constraints placed on physicians, either by the hospitals themselves or through Medicare's utilization review system of Peer Review Organizations (PROs), changed with the enactment of PPS, then the pattern of declining admissions is predictable. In addition, outpatient treatment has become much more the medical norm in recent years as technologies have changed and as payors have realized the potential savings to be realized from minimizing hospitalization. These trends suggest that less ill patients are being treated in outpatient settings, and, as a result, the average severity of illness at admission has risen as well.

This paper estimates what changes have occurred concurrent to the decline in admissions, both in severity itself and in hospital utilization while holding constant severity. Use of fairly unique measures of patient severity at admission and discharge linked with utilization data permits a more precise analysis of hospitalization patterns than do standard proxies for severity such as the Medicare case mix index. There is certainly a common perception that average patient acuity has increased in recent years, but an empirical test of this proposition is important. In addition, it would be useful to determine whether patient severity is in fact a good predictor of resource use.

The paper analyzes changes between 1982 and 1985 in severity at admission and discharge, length of stay, in and post-hospital death rates and rehospitalization. 1982 and 1985 are chosen because they represent time points shortly before and after the implementation of Medicare´s prospective payment system (PPS). As is true for any study of the effect of a new regulation, however, unless it is possible to control for all other changes in the health care system that may have occurred between 1982 and 1985, it is inappropriate to attribute any measured changes solely to PPS. Trends in many of the measures analyzed in this paper begin before the advent of PPS. For example, length of stay began to decline in 1980.

The analysis suggests that both admission and discharge severity may have increased between 1982 and 1985. Holding constant the increase in admission severity yields larger estimates of the decline in average length of stay observed by many other studies. It does not appear, however, that shortened lengths of stay have led to increased readmissions or higher post-hospital mortality rates in any obvious manner.

II. Data

Each observation is a Medicare hospital discharge in 1982 or 1985 from one of nine hospitals diagnosed with pneumonia (ICD-9 categories 481, 482, 483, 485 and 486) or stroke (ICD-9 codes 431, 433, 434, 435 and 436), or having undergone a hip replacement (ICD-9 categories 81.5 and 81.6). The advantage of analyzing distinct disease categories rather than aggregate hospital patient flow is that it removes any bias created by a changing hospital case mix. For example, there is some suggestion that the proportion of Medicare admissions for conditions associated with higher than average likelihood of death has risen in recent years.[2] If this is true, simple mortality trends may be misleading.

Basic data on patient characteristics, their hospital visits, and use of post hospital care were derived from the Health Care Financing Administration´s (HCFA) MEDPAR data as well as bill record files.

Severity at admission and discharge is measured by the Medical Illness Severity Grouping Systems (Medisgrps), a software system developed by MediQual Systems, Inc., a firm that specializes in quality assurance reviews for hospitals. Medisgrps was developed by a group of physicians. Severity is coded into five different categories based on an examination of key clinical findings in the patient´s record such as laboratory, radiology, pathology, and physical exam results. Higher severity levels imply higher probability of organ failure. The categories are defined as follows:

0: Patients admitted on a symptomatic basis with no key clinical findings.

1: Patients with minimal findings and minimal illness whose likelihood of going into organ failure is low.

2: Patients with either acute findings and illness for whom the likelihood of organ failure in the short term is uncertain or with severe findings and illness with a high potential for future, but not imminent, organ failure absent treatment.

3: Patients with both acute and severe findings who are likely to go into organ failure imminently without treatment.

4: Patients with critical findings indicating present organ failure who are likely to die without immediate treatment.

Patients are classified 48 hours after admission (to allow enough time for all the relevant finding to be placed on the patient's record) and again at various points during the patient's stay.[3] For the purpose of this study, MediQual also calculated severity at discharge, but this is not part of their normal rating system.

Medisgrps is one of several competing methods that classify patients according to their severity. All of these classification systems are designed to aid quality assessment and payment review by refining case mix measurement beyond the adjustments done by the Diagnosis Related Group (DRG) classification system which was designed on the basis of cost. Major competitors include the Severity of Illness Index (SOII) which has been recently revised to become the Computerized Severity Index (CSI), APACHE, Disease Staging and Patient Management Categories (PMCs). There are at least two discussions in the literature of the relative merits of all five systems, so only brief descriptions of each are provided here.[4] [5]

The SOII/CSI measure was developed as a refinement to DRGs. Like Medisgrps, SOII/CSI gives each patient an overall numerical score, ranging from one to four, based on his/her "burden of illness." The rating is developed from a trained abstractor's overall view of seven dimensions of the patient's record. Unlike Medisgrps, SOII/CSI relies on the subjective judgment of the abstractor. It was also not developed from empirically tested relations between measured severity and health outcome as was Medisgrps, but rather relied on physician judgment.

APACHE was developed for and pertains only to patients receiving intensive care. It rates the degree to which a patient is critically ill on a scale of 1 to 71 and calculates a probability of death based on various test results collected upon admission to the ICU, age, and a chronic health evaluation. Apart from the chronic health evaluation, APACHE's ratings are based on objective criteria; its limitation stems from its applicability only to intensive care patients.

Disease Staging applies to diagnoses rather than patients. Therefore, it is difficult to generalize across disease categories. Four stages of increasing severity apply to each of 420 disease categories, and each patient is classified according to disease and stage. Disease staging is vulnerable to the same kind of "upward creep" in complexity as are DRGs.[6]

The PMC classification assigns patients to one of 820 categories grouped into 47 modules each representing a disease category based on diagnoses and procedures. Within each module further classification is made on the basis of expected cost of required treatment. This methodology is similar to that used to create DRG classifications and suffers from the same gaming problems and difficulty in determining resource needs on the basis of limited information. In addition, it is difficult to generalize across disease categories.

Medisgrps, as noted above, relies on key clinical findings from patient records and thus passes the objectivity test. Since it is patient rather than disease-based it enables comparisons across disease categories. In addition it was empirically derived. Since severity is based on test results, a potential problem with Medisgrps is that the severity rating could in part be determined by the number of tests performed on a patient. On the other hand, only two tests are sufficient to produce the maximum severity rating.

Medisgrps appears to be gaining in popularity among hospitals and third party payors. Four Rochester, NY hospitals have recently agreed to have their payments from Blue Cross adjusted for severity as measured by Medisgrps.[7] Similarly, Blue Cross of Minnesota has agreed with some 40 Minneapolis-area hospitals adjust payments per case to hospitals within a 5 percent range according to Medisgrps severity ratings.[8]

The data set includes 306 pneumonia discharges, 744 stroke discharges and 212 hip replacement discharges. Clearly, the data do not represent a random sample of anything. They are from a

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few select hospitals that had already contracted with MediQual for review services. They represent three relatively common disease categories that grew both in number (when most admissions were declining) and relative importance between 1982 and 1985. According to Medpar data, in 1982 the three categories represented 6.2 percent of all admissions while by 1985 they accounted for 9.2 percent. It is also impossible to generalize widely across the three categories; although certain similar patterns emerge, important differences remain.

The next section provides some descriptive statistics on the variables of interest. In the following section some simple regression results that control for patient demographic and hospital characteristics are described.

III. Descriptive Statistics

Table 1 shows the relative frequency by disease category of admission and discharge severities in 1982 and 1985. To simplify the analysis, the least serious categories 0 and 1 have been grouped together as have the most severe groups 3 and 4. For the discharge severity groupings, death in the hospital (implying death at discharge) is treated as a separate category. For all three categories, a smaller proportion of patients was admitted in the least severely ill categories (0-1) in 1985 relative to 1982. Similarly a larger proportion of patients were admitted in the most severe categories in 1985. These statistics suggest that the observed pattern of declining admissions has in fact led to a more severe casemix in the hospital even within specific

TABLE 1

SEVERITY LEVELS AT ADMISSION AND DISCHARGE

Disease Category/ Severity Level	At Admission				At Discharge			
	1982		1985		1982		1985	
	#	%	#	%	#	%	#	%
Pneumonia								
0-1	15	14.0	18	9.1	81	77.2	138	71.9
2	49	45.8	79	39.7	8	7.6	23	12.0
3-4	43	40.2	102	51.3	4	3.8	6	3.1
Death					12	11.4	25	13.0
Total*	107		199		101		192	
Stroke								
0-1	136	37.5	111	29.1	271	83.2	284	79.3
2	141	38.8	162	42.5	14	4.3	30	8.4
3-4	92	23.7	108	28.4	6	1.8	6	1.7
Death					35	10.7	38	10.6
Total*	369		381		326		358	
Hip Replacement								
0-1	55	62.5	57	46.0	85	97.7	119	96.0
2	26	29.6	52	41.9	1	1.2	4	3.2
3-4	-	-	-	-	-	-	-	-
Death					1	1.2	1	.8
Total*	81		109		87		124	

*Admissions totals do not equal discharge totals because a few discharges were not coded for severity. Their admission severities do not exhibit any distinct pattern.

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disease categories. Chi-square tests indicate that the stroke and hip differences in admission severity are significant at greater than 10 percent levels. It is possible that the reduction in low severity admissions implies that fewer admissions were inappropriate in 1985 than in 1982, but without some well-defined standard of "inappropriate" this is difficult to ascertain.

The results for discharge severity are not as clear. While for all three disease groups, a smaller proportion of patients was discharged in the least severe categories in 1985 than in 1982, differences between years are very small and insignificant. Moreover, for pneumonia and stroke, a smaller proportion was also discharged in the most severely ill categories in 1985, although, again, the differences are insignificant.

From the raw data, it also does not appear that significant changes have occurred in the proportion of patients who die in the hospital in these three disease categories. Figure 1 shows mortality rates in the hospital and within 30, 60 and 90 days of admission to examine whether the apparently more severe casemix in the hospital is resulting in a higher proportion of deaths among the hospitalized population. Again no clear pattern of change between 1982 and 1985 emerges.

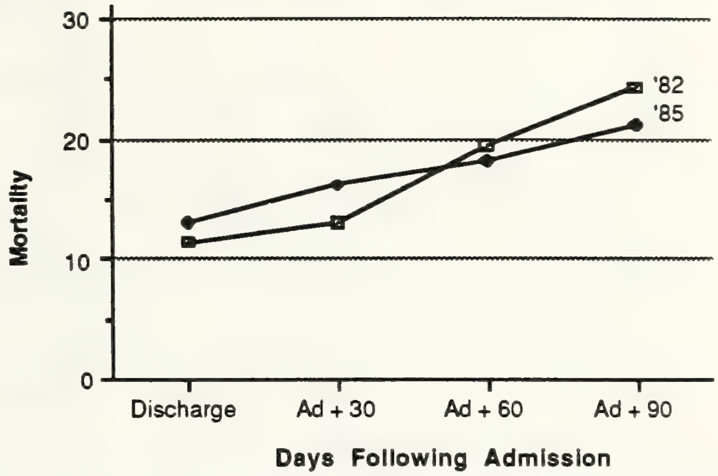
If patients are more severely ill at discharge, they may be leaving the hospital earlier in their recovery period. If so, on average, lengths of stay may be shorter. On the other hand, if greater discharge severity is attributable to concomitant

FIGURE 1

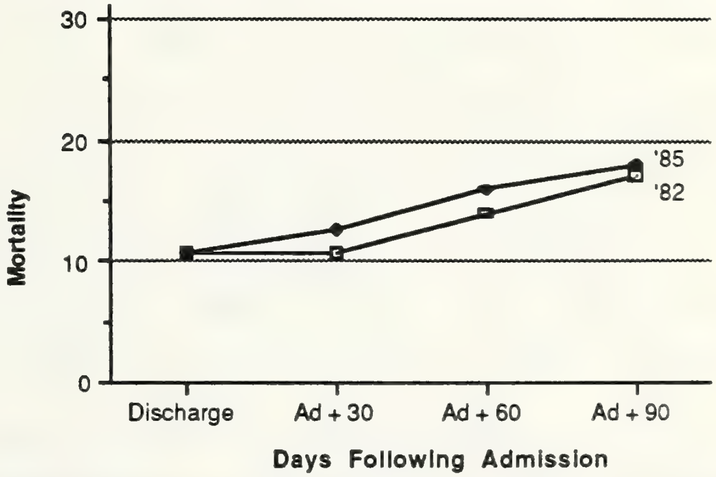
Mortality Rates Within Specified Periods of Time Following Hospitalization

(1982-1985)

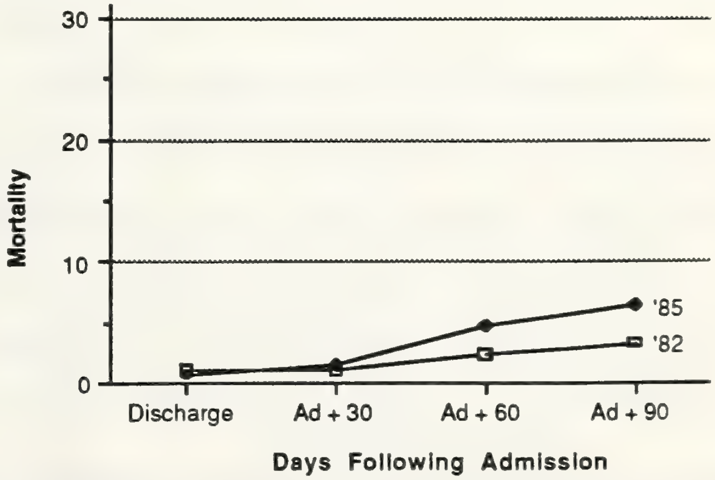
Pneumonia



Stroke



Hip Replacement



increases at the time of admission, length of stay may not have changed. As has been widely reported and as Figure 2 shows, mean lengths of stay for all live discharges are in fact shorter for all three disease categories and for all levels of severity. The same holds true when dead discharges are included in the sample. As Table 2 shows, stroke and hip replacement cases also experienced declines in median lengths of stay, albeit of a smaller magnitude. The smaller declines in median (than mean) lengths of stay suggest that a significant change in length of stay between 1982 and 1985 was a decline in the number of very long lengths of stay. Both the range and the coefficient of variation decline from 1982 to 1985 for all three disease categories when live discharges are studied and for stroke and hip cases when all discharges are considered.

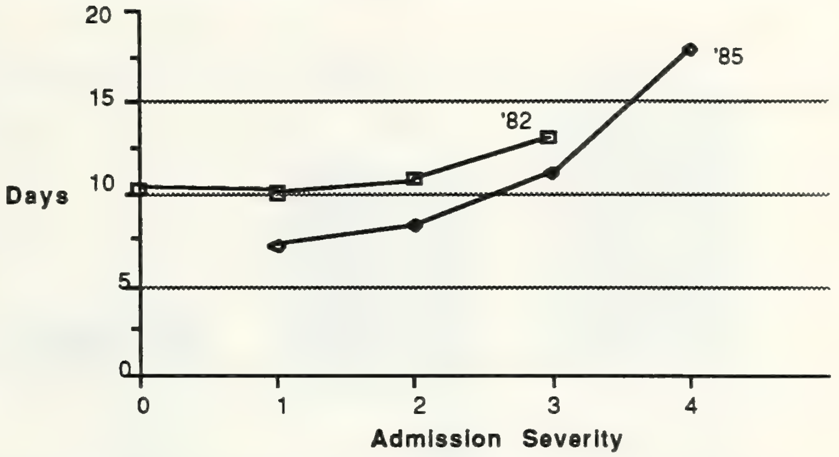
Earlier discharges from the hospital may lead to increased rehospitalizations if less care is provided during the initial stay. Since shortened stays may also provide benefits, this does not necessarily imply that the change is detrimental on average; some positive level of admissions is planned or otherwise appropriate. Sharp increases over time, however, may warrant investigation. The data presented in Figure 3, which show rehospitalization rates within certain time periods following discharge suggest that the 1982-1985 comparisons in rehospitalization vary significantly across disease categories. Pneumonia rehospitalization rates did not change. For stroke, there is a substantial increase in the number of patients rehospitalized,

FIGURE 2

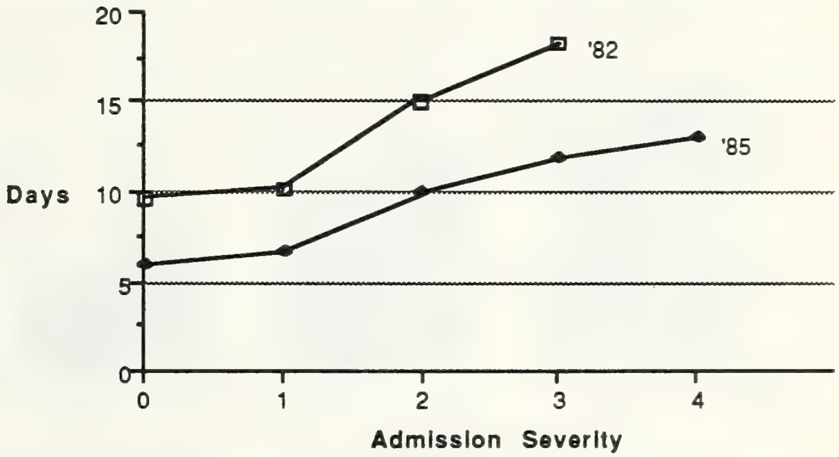
Length of Stay by Year and Admission Severity

(Live Discharges Only)

Pneumonia



Stroke



Hip Replacement

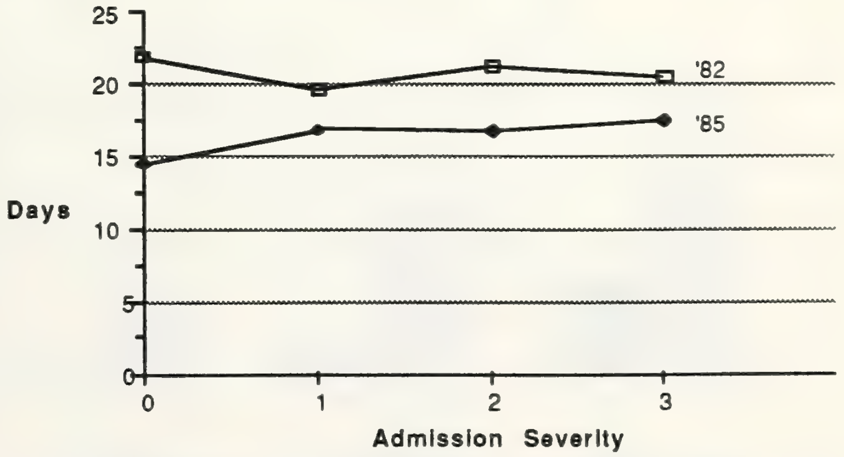


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TABLE 2

LENGTH OF STAY

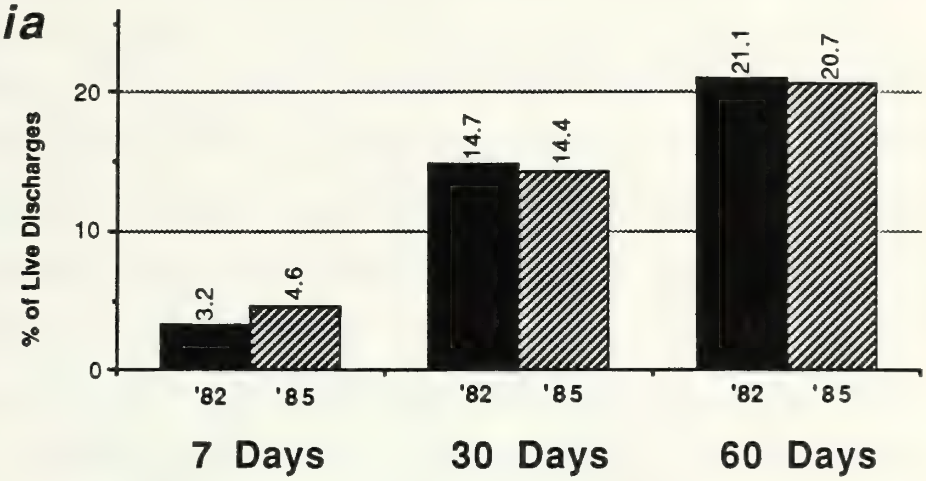
	Pneumonia		Stroke		Hip Replacement	
	1982	1985	1982	1985	1982	1985
Live Discharges Only						
Mean # of Days	11.5	9.6	13.6	9.4	21.0	16.2
Median # of Days	9	9	9	8	17	15
Coeff. of Variation	67.1	60.3	101.8	81.6	44.7	35.8
Range	2-53	1-42	1-106	1-61	9-55	6-44
All Discharges						
Mean # of Days	11.2	9.9	13.8	9.4	20.8	16.3
Median # of Days	9	9	9	7	17	15
Coeff. of Variation	69.3	82.1	99.8	90.2	45.7	35.8
Range	1-53	1-86	1-106	1-66	4-55	6-44

FIGURE 3

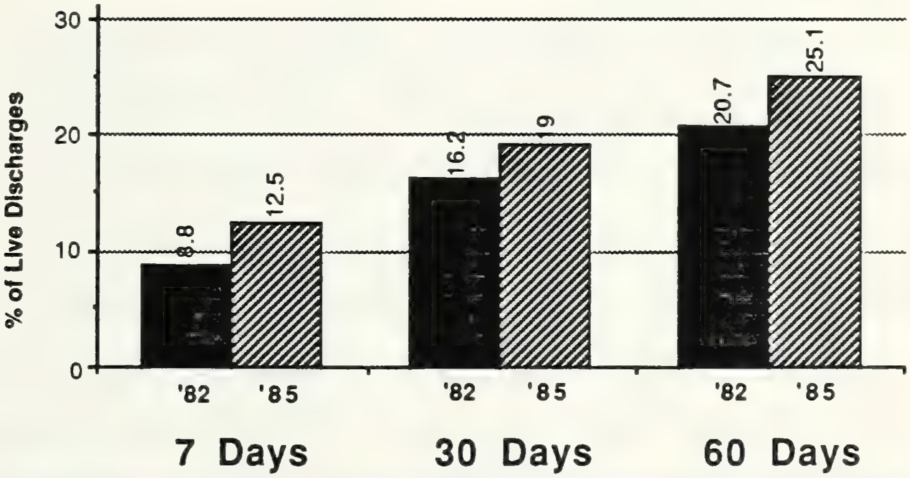
Percent of Live Discharges Who Are Rehospitalized

(By Year and Number of Days Following Discharge)

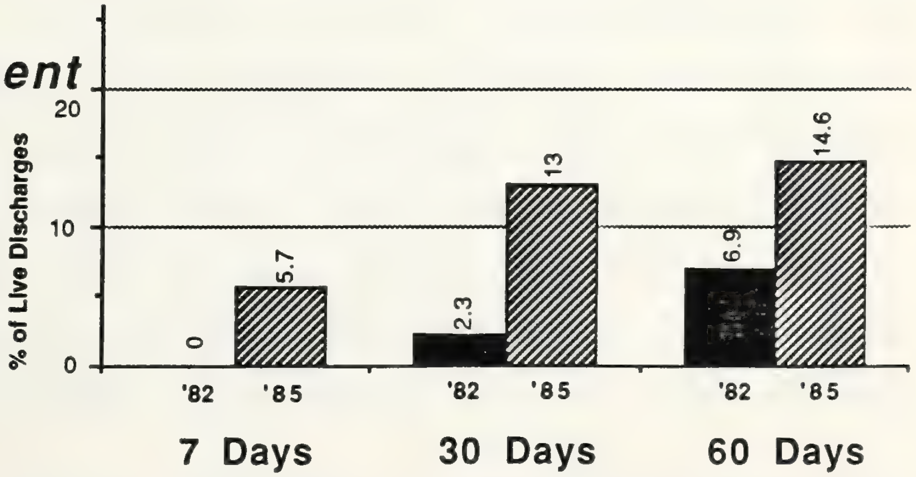
Pneumonia



Stroke



Hip Replacement



but the difference diminishes over time (42 percent more patients (in proportional terms) were readmitted within seven days in 1985, while 24 percent more were readmitted within 60 days.) Finally, for hip replacements there was a large increase in the proportion of readmitted patients between 1982, when none were readmitted in the first 14 days and few thereafter, and 1985. Since the PROs review readmissions within the first 14 days, it would not be surprising to find a larger increase after 14 days when appropriateness is less carefully scrutinized by reimbursement authorities, but this does not appear to be the case for any disease category.

If patient severity is going to be used as a control in measuring outcomes, such as length of stay, death or rehospitalizations, then it is important to determine how closely related it is to such outcomes. If it proves not to be highly correlated with outcome then accounting for patient severity is less important. From Figure 2 which depicts the drop in length of stay between 1982 and 1985 we can also examine the relation between severity at admission and patient severity. It appears that for all three disease categories the relation between severity and length of stay became stronger between 1982 and 1985 as evidenced by the steeper 1985 lines. In addition, substantial variation exists across the three disease categories in the relation between severity and length of stay. While there is an evident pattern for pneumonia and stroke cases, the relation appears slight for hip replacements. This may be because hip replacement patients are generally otherwise healthy individuals, and very few are even admitted in a severity category of greater than 2.

There is an obvious relation between Medisgrps severity ratings and mortality within various time periods following admission as shown in Figure 4. Severity groupings 0 and 1 have been grouped together because the death rates of those patients were insignificantly different from each other. For pneumonia and stroke cases, the real distinction appears to lie between patients with an admission severity rating of 2 or less and those with severity of 3 or 4. Admission with severity 4 appears to be associated with a considerably higher probability of death. For hip replacements, so few people die that it is difficult to draw conclusions, but a similar relation between severity and death appears to hold. MediQual's internal analysis of its data reveals a similar pattern. In a sample of over 217,000 discharges from client hospitals, the average mortality rate at discharge was .2 percent for severity 0, .7% for severity 1, 3% for severity 2, 16% for severity 3 and 66% for severity 4.[9] For pneumonia cases, the percentages from this sample are 0 for severities 0 and 1, 3.1 for severity 2, 22.1 for severity 3 and 40 for severity 4. Similarly, 6 percent of stroke cases admitted in severity class 0 or 1 die in the hospital, compared with 6.2 in severity 2, 24.1 in severity 3, and 71.4 in severity 4.

The relation between rehospitalization and discharge severity, shown in Figure 5, is more mixed. 1982 and 1985 data

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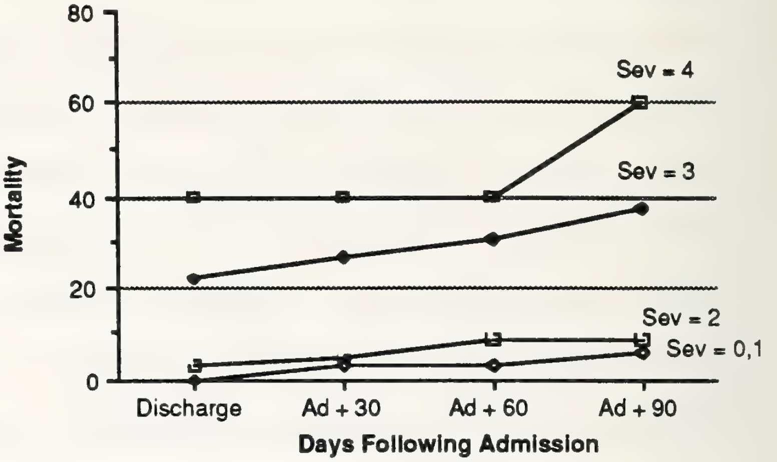
FIGURE 4

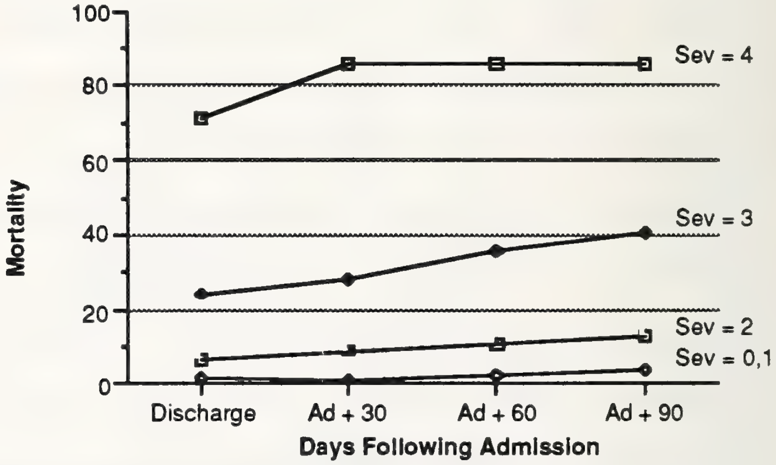
Mortality Rates Within Specified Periods of Time Following Hospitalization

(By Severity at Admission)

Pneumonia



Stroke



Hip Replacement

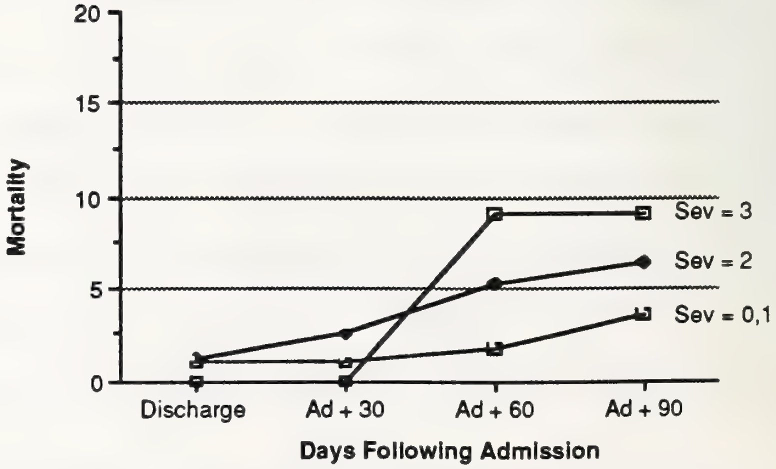
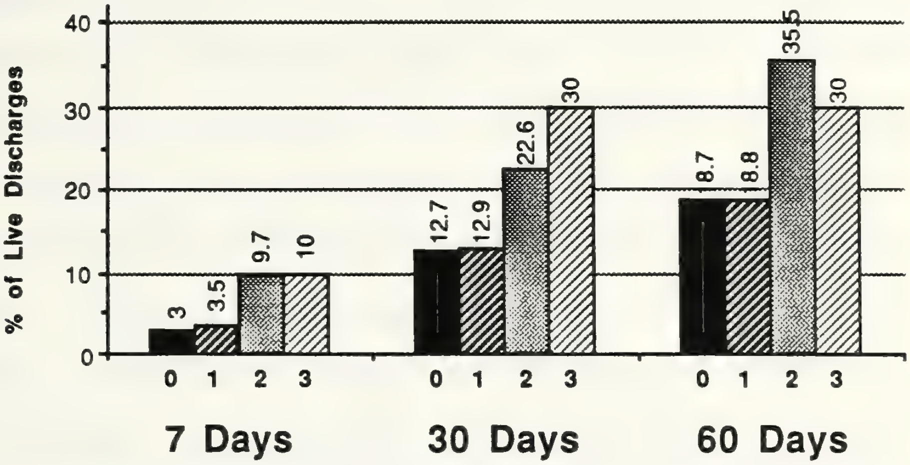


FIGURE 5

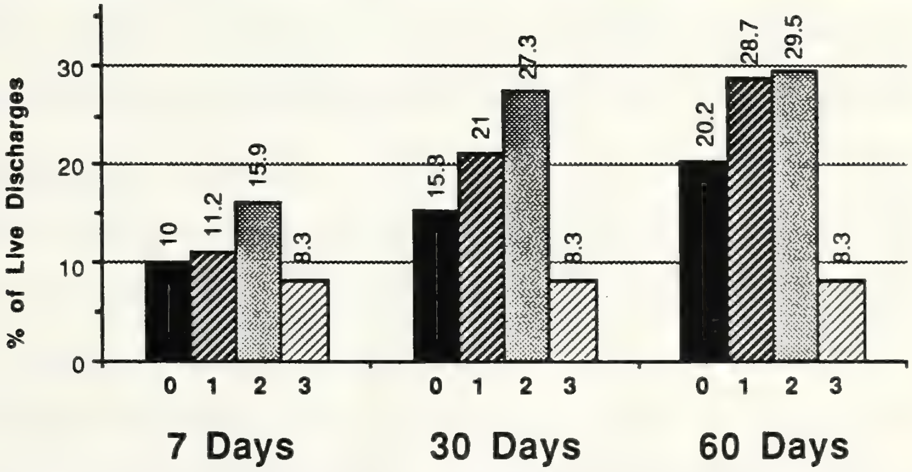
Percent of Live Discharges Who Are Rehospitalized

(By Discharge Severity and Number of Days Following Discharge)

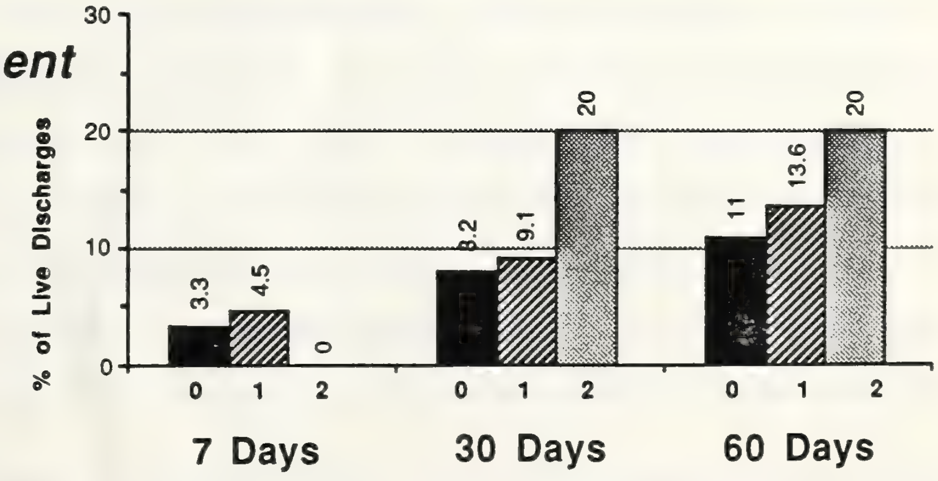
Pneumonia



Stroke



Hip Replacement



have been combined in this table since the total number of readmissions is sufficiently small to make separate analysis by severity and year meaningless. For severity ratings 0-2 there appears to be a direct relation between severity at discharge and subsequent readmission for all three disease categories analyzed, but the pattern varies across diseases. There are so few cases discharged in severity class 3 that no conclusions are possible.

IV. Regression Results

The descriptive statistics presented above measure the change between 1982 and 1985 in various measures of severity and utilization without holding constant any other factors that may themselves vary between the 1982 and 1985 patient populations. While the descriptive statistics presented above suggest some changes between 1982 and 1985, it is impossible to draw firm conclusions without controlling for other factors that might affect severity and utilization. In the regressions reported below, patient characteristics such as age, race, and sex are measured. Also important are hospital and market-specific factors such as local practice styles or the degree of competition. Both of these effects are controlled for by dummy variables indicating to which of the nine hospitals in the sample each patient was admitted.

To isolate the impact of PPS it would also be necessary to account for any other significant changes that occurred in the health care system between 1982 and 1985. Unfortunately, this is not possible with existing data. The regressions include a dummy variable to measure differences in each variable analyzed between 1982 and 1985, but it is not possible to attribute definitively any measured changes solely to PPS. Any trends over the time period, regardless of their cause, will be measured by the 1985 dummy variable. However, since PPS was one significant change that did occur between 1982 and 1985, it is not unreasonable to speculate that any changes uncovered are, at least in part, attributable to PPS.

The regressions below (except where admission severity is the dependent variable) all include admission severity as an explanatory variable in addition to the 1985 dummy, patient characteristics and hospital identifiers. Where appropriate, length of stay and intensive/coronary care use are also included as utilization measures. Both are thought to affect outcomes, and although they may have, themselves, changed between 1982 and 1985, they should be accounted for in regressions. Such an analysis permits addressing questions concerning how various changes in utilization interact.

The tables below present coefficients for the key variables of interest: the dummy indicating a 1985 admission, and where appropriate, severity, length of stay, and intensive/coronary care use. Discussion will focus primarily on these variables. All of the regressions also include the patient demographic descriptors and hospital dummy indicators discussed above. To avoid overwhelming the reader with numbers that are not directly relevant to the topic at hand, however, the tables do not include

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the coefficients for these variables. Discussion in the text notes which control variables are significant, and the complete results are available from the author.

Many of the dependent variables are discrete in nature (either 0-1 binary dummy variables, or, in the case of severity, 5 categories). Therefore, standard ordinary least squares (OLS) regression techniques produce statistically inefficient estimates. Probit and logit techniques were, therefore, also used to test the robustness of the OLS results. For several reason, however, the OLS results are presented rather than the qualitative response results. First, the latter results do not differ significantly from the OLS results; second, the non-linear logit and probit regressions did not always converge, third, the OLS coefficients are easier to interpret. To the extent that the probit and logit methods provide any additional or conflicting information, their results are mentioned. The qualitative response model results are available from the author.

A. Admission Severity

As Table 3 shows, even after controlling for patient and hospital characteristics, the 1985 dummy variable suggests that admission severity increased between 1982 and 1985. Only for pneumonia, however, is the effect highly significant. Ordered logit estimations of admission severity also suggest that it increased between 1982 and 1985. Age is a significant determinant of admission severity in most of the regressions. A few of the hospital dummies are also significant, especially in the

TABLE 3

Severity at Admission and Discharge
(t-statistics in parentheses)

	Disease Category		
	Pneumonia	Stroke	Hip Replacement
ADMISSION SEVERITY			
1985 DUMMY	.205 (2.46)	.131 (1.91)	.210 (1.50)

DISCHARGE SEVERITY

Sample: Live Discharges Only

	Pneumonia	Stroke	Hip Replacement
1985 DUMMY	.139 (1.25)	.119 (2.06)	.035 (.55)
ADMISSION SEVERITY	.139 (1.69)	.210 (6.49)	.079 (2.61)
INTENSIVE CORONARY CARE	.171 (1.09)	-.041 (-.64)	.322 (2.29)
LENGTH OF STAY	.001 (.07)	.003 (1.20)	.012 (2.83)

stroke regressions. This suggests either that case-mix varies across hospitals for stroke or that different severity coding procedures are being used by some of the hospitals. It should also be noted that the total explanatory power of the OLS regressions is quite small, ranging from .09 for the stroke regression to .18 for the hip replacement equation. The ordered logit regressions are also not accurate predictors of severity ranking. This suggests that we are not measuring the determinants of admission severity very well or that the measures of admission severity are themselves flawed. Since admission severity is not likely to be strongly affected by other variables that were themselves influenced by changes between 1982 and 1985, only reduced form regressions of admission severity are estimated.

B. Discharge Severity

The discharge severity regressions contain all patients discharged alive. In addition to the control variables and the 1985 dummy variable, the regressions contain admission severity, length of stay, and intensive/coronary care use. Discharge severity should be influenced by illness at admission (admission severity) as well as measures of treatment while in the hospital such as intensive care use or length of stay. All of these variables, however, may themselves have changed between 1982 and 1985. For example, we have already shown that admission severity was higher in 1985 than in 1982. Therefore our measure of change between 1982 and 1985 derived from the 1985 dummy variable will reflect only those changes in discharge severity that are not imbedded in changes in admission severity, length of stay or intensive/coronary care use.

Regressions estimating the discharge severity of live discharges suggest that discharge severity levels may have increased between 1982 and 1985 even after holding constant increased admission severity. However, the results are significant at the 10% or greater level for stroke cases. Admission severity, itself, has a reasonably significant positive effect (at 1-tailed levels) for all disease categories.

Intensive care use has a positive and significant effect on hip replacement discharge severity, but is insignificant and of different signs for the other two cases. The positive coefficient may be explained as follows: while the patients who receive intensive or coronary care may be discharged at lower severity levels than they would have been absent such care, they are probably sicker than average. Admission severity affects the likelihood of intensive/coronary care use positively and significantly for pneumonia and stroke cases which may be why no effect appears on the intensive/coronary care coefficient when admission severity is included in the regression. Intensive/coronary care use is measured as a dummy variable indicating admission to an intensive or coronary care unit. An alternative variable measuring number of days in intensive or coronary care facilities produced similar results.

Length of stay has a small positive, but insignificant effect on the discharge severity of pneumonia and stroke patients and a significantly positive effect in the hip replacement regressions. The ordered logit regressions of discharge severity are similar to the OLS regressions: the 1985 dummy variables are somewhat more significant while most of the other variables are less so; length of stay for stroke cases is somewhat more significant than in the OLS regressions with a t-statistic of 1.5. It was initially expected that holding admission severity constant, longer lengths of stay should reduce discharge severity. This effect does not appear in the regressions, however.

An alternative specification of the discharge severity regressions included those patients discharged dead in the sample by assigning them a severity rating of 5. These results are not presented, but the differences from those for live discharges only are described briefly. The coefficient on the 1985 dummy becomes smaller and loses significance for all three disease categories. Admission severity, on the other hand increases in importance for pneumonia and stroke cases. Most interesting, intensive/coronary care use has a positive and significant effect (with t-statistics all exceeding 4) on discharge severity. It was initially expected that, holding admission severity constant, intensive/coronary care use would improve patient outcomes and have a negative effect on discharge severity. The results suggest that the more likely explanation is that intensive/-coronary care use is a good predictor of death.

In general the results for discharge severity are weak. While it appears that higher admission severity levels may be leading to somewhat greater severity at discharge, little evidence in these results supports the notion that patients are being discharged "quicker and sicker."

C. Length of Stay

One of the most widely reported trends over the last few years has been declining lengths of stay. The descriptive statistics reported earlier confirmed other findings, but they may underestimate the magnitude of length of stay declines if the higher admission severities found in earlier regressions have an offsetting effect. Regressions results are reported in Table 4 for both the sample of live discharges only and for all discharges. Since the length of stay of patients discharged dead may be determined by different factors than those discharged alive, the results may vary. In addition to the patient and hospital control variables, admission severity and intensive/coronary care use are included in both sets of regressions since they are likely to affect length of stay.

Comparisons of the 1985 dummy variable coefficients with the percentage reductions in mean length of stay derived from the descriptive statistics suggest that holding admission severity constant does increase the measured decline in length of stay, at least for pneumonia and stroke cases. For the sample of live discharges, pneumonia length of stay declines increase by 11 percent (to 2.1 days from 1.9 days) while stroke length of stay

TABLE 4

Length of Stay
(t-statistics in parentheses)

	Disease Category		
	Pneumonia	Stroke	Hip Replacement
SAMPLE: LIVE DISCHARGES			
1985 DUMMY	-2.069 (-2.58)	-5.136 (-6.15)	-4.670 (-4.46)
ADMISSION SEVERITY	1.626 (2.80)	2.806 (6.06)	-.2371 (-.45)
INTENSIVE CORONARY CARE	3.888 (3.51)	4.768 (4.94)	3.173 (1.29)
SAMPLE: ALL DISCHARGES			
1985 DUMMY	-1.442 (-1.57)	-4.990 (-6.14)	-4.479 (-4.24)
ADMISSION SEVERITY	1.503 (2.27)	2.258 (5.15)	-.0860 (-.16)
INTENSIVE CORONARY CARE	4.486 (3.89)	4.582 (5.01)	3.441 (1.47)

declines rise by 21 percent (from 4.2 days to 5.1 days). Since admission severity and intensive/coronary care use have no effect on length of stay for hip replacement cases, it is not surprising that for hip replacements the regression coefficients portray the same reduction as the simple statistics. Since the results for the complete sample of patients (including those discharged dead) are very similar to those just described, they will not be discussed.

Plots of the data suggest that the distribution of length of stay actually is closer to lognormal than normal, which is also evidenced by the discrepancies between mean and median levels and declines. Regressions were therefore run using the natural log of length of stay as the dependent variable. The results are qualitatively similar although the measured percentage change between 1982 and 1985 was smaller as suggested by the smaller median differences.

D. Death Rates

None of the regression findings reported thus far imply that the quality of care received in the hospital became less optimal between 1982 and 1985, but if mortality or rehospitalization rates increased substantially, some concern may be warranted.

While the evidence in this paper is weak, if patients are in fact being discharged earlier and sicker, in-hospital death rates may have declined between 1982 and 1985 as patients are discharged to die at home or in post-hospital care facilities.

Conversely, post-hospital death rates may have risen. The regression coefficients shown in Table 5 do not support this hypothesis. Controlling for admission severity and intensive/coronary care use, the 1985 variable is totally insignificant. Admission severity is positively and significantly related to pneumonia and stroke hospital mortality rates, as suggested by Figure 4. Intensive/coronary care use has a positive and significant effect for all three disease categories suggesting again that intensive care use is an indicator of severity.

We examine (also in Table 5) the death rates of live discharges within 60 and 90 days of admission to separate post-hospital deaths from in-hospital mortality. Holding constant discharge severity, which itself has a positive effect on subsequent death, it appears that the post-hospital death rate declined between 1982 and 1985, although the result is only significant for 90-day pneumonia rates. Logit regressions show essentially the same effects, although the hip replacement 60 day death rate regressions did not converge to any meaningful results.

E. Rehospitalization Rates

Concern has been expressed over whether early discharges from the initial hospital stay are leading to increased rehospitalizations. The measure analyzed here is a dummy variable indicating whether or not rehospitalization occurred within a time window, although regressions of the number of rehospitalizations are also mentioned below. In general, the number of

TABLE 5

Death Rate Regressions

	Disease Category		
	Pneumonia	Stroke	Hip Replacement
DEATH AT DISCHARGE			
1985 DUMMY	-.015 (-.39)	-.022 (-1.04)	.005 (.33)
ADMISSION SEVERITY	.111 (4.10)	.086 (7.54)	-.004 (-.52)
INTENSIVE CORONARY CARE	.188 (3.98)	.116 (4.87)	.108 (3.44)
DEATH WITHIN 60 DAYS (but not in the Hospital)			
1985 DUMMY	-.052 (-1.49)	.008 (.41)	.021 (.87)
DISCHARGE SEVERITY	.063 (3.14)	.081 (5.85)	.081 (2.84)
DEATH WITHIN 90 DAYS (but not in the Hospital)			
1985 DUMMY	-.080 (-1.96)	-.012 (-.53)	.026 (.87)
DISCHARGE	.085 (3.58)	.113 (7.06)	.097 (2.84)

patients with more than one readmission during the time window studied is trivial. While, analysis of longer time spans following hospitalization would generate more individuals with multiple hospital readmissions, it would be less clear that the time span studied represents a single episode of illness.

The frequencies reported earlier suggest that readmission rates were in fact higher in 1985 for stroke and hip replacement patients within the first 60 days of discharge. Equations that hold constant discharge severity reported in Table 6 also show significant increases in rehospitalization rates for hip cases within the first 30 days and positive, but less significant, increases 60 days following discharge. The stroke regressions also suggest positive, but less significant changes between 1982 and 1985. These results imply that it is incorrect to attribute any increased rehospitalizations solely to the more ill condition in which patients may be discharged. If this were the explanation, the 1985 variable should be insignificant and small when discharge severity is included in the regression. However, regressions that omit discharge severity as an explanatory variable produce coefficients on the 1985 dummy variable of similar size and significance. Discharge severity itself has a positive effect on readmission rates for all three disease categories, although the effect is not always significant by common statistical benchmarks. These results suggest that patients who are discharged in a sicker condition are more likely to be rehospitalized, but other factors are also necessary to

TABLE 6

REHOSPITALIZATION RATES
(t-statistics in parentheses)

	Disease Category		
	Pneumonia	Stroke	Hip Replacement
DUMMY VARIABLE INDICATING READMISSION WITHIN 7 DAYS			
1985 DUMMY	.0078 (.29)	.0426 (1.66)	.0571 (2.21)
DISCHARGE SEVERITY	.0273 (1.75)	.0195 (1.08)	.0063 (.21)
DUMMY VARIABLE INDICATING READMISISON WITHIN 14 DAYS			
1985 DUMMY	.0078 (.29)	.0354 (1.33)	.0705 (2.39)
DISCHARGE SEVERITY	.0273 (1.75)	.0294 (1.57)	.0238 (.70)
DUMMY VARIABLE INDICATING READMISISON WITHIN 30 DAYS			
1985 DUMMY	-.0268 (-.40)	.0275 (1.04)	.0912 (2.26)
DISCHARGE	.0522 (1.96)	.0400 (1.80)	.0385 (.83)
DUMMY VARIABLE INDICATING READMISSION WITHIN 60 DAYS			
1985 DUMMY	-.0230 (-.44)	.0503 (1.44)	.0627 (1.33)
DISCHARGE SEVERITY	.0625 (2.04)	.0376 (1.53)	.0419 (.77)

explain the increase in rehospitalizations between 1982 and 1985. It should be noted, that pneumonia cases show no evidence of higher readmission rates as was suggested by Figure 3. Average lengths of stay fell less between 1982 and 1985 for pneumonia cases than for the other two categories, and the increase in pneumonia discharge severity, while substantial, was statistically insignificant. Discharge severity, however, has its most significant effect on pneumonia rehospitalizations.

Logit regressions on the rehospitalization dummy variable result in identical conclusions. When the number of rehospitalizations within the various time windows is used as the dependent variable rather than the dummy specification, some differences arise. Discharge severity has a more significant effect on pneumonia rehospitalization within 7 and 14 days of discharge and on hip replacement rehospitalizations within 30 and 60 days. The 1985 dummy coefficient becomes more significant (approaching a t-statistic of 2) for stroke rehospitalizations.

V. Summary

Average severity of patients´ condition upon admission to the hospital appears to have increased between 1982 and 1985. It is not possible to make definitive statements about discharge severity: the same implication of increased severity is consistent with the findings, but the results are much weaker. Length of stay has obviously declined, and holding constant admission severity increases the measured decline for pneumonia and stroke cases. Declines between 1982 and 1985 range from 18 to 38 percent. Shortened lengths of stay, however, do not appear to be the cause of increased sickness at discharge. While rehospitalization rates appear to have increased in two of the three disease categories studied, the regressions imply that higher discharge severity is not the total explanation. While higher severity is related to an increased probability of death, death rates following hospitalization, themselves, do not appear to have increased between 1982 and 1985, and may even have declined.

These results can at best be taken to suggest certain results from the implementation of PPS. Since only two years of data are available, without controlling for all of the other changes that occurred to health care delivery between 1982 and 1985, we cannot be sure that any measured changes are attributable solely to PPS. In addition, as noted earlier, the samples of patients, providers, and diseases are limited and not random. On the other hand, measurement of differences in patient severity, such as that accomplished by using the Medisgrps data, is crucial to understanding patterns in utilization and outcome. Moreover, analysis at the disease level mitigates some problems found in more aggregate studies. The results of this study point out some patterns that warrant further investigation.

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MEDICARE USE IN THE LAST 90 DAYS OF LIFE

Working Paper

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Abstract

To analyze changes in the use of Medicare-covered services during the last 90 days of life, we examined data on more than 34,000 Medicare beneficiaries who died during the years 1982 to 1986. The sample was drawn from the 5 percent Medicare eligibility file. Descriptive analysis and regression analysis were used to estimate changes in hospital mortality rates, hospitalization rates, use of other types of Part A and Part B services, and reimbursements within the last 90 days of life.

The use of health services by Medicare beneficiaries during the last 90 days of life has changed markedly since the introduction of the prospective payment system (PPS) in late 1983. The percentage of deaths occurring in hospitals has decreased over the period from 1982 to 1986, and in the post PPS period (p=.009); this effect is largely because of reductions in length of stay rather than admission rates, which have not been significantly affected by PPS. Use of home care, durable medical equipment (DME), and physicians' office services during the last 90 days of life has increased since PPS was introduced. There is no consistent evidence that PPS has been associated with these changes or in the level or combination of Medicare expenditures during the last 90 days of life. In real terms, Medicare spending in this period of life has remained at about $3,500 (in 1979 dollars); about 75 percent of these reimbursements continue to be hospital payments. There is also no evidence that access to hospital services or to Medicare services in general has been altered by PPS.

Introduction

This paper examines changes in Medicare use during the last 90 days of life and focuses on the role of the prospective payment system (PPS) in these changes. Introduced in late 1983, the PPS was intended to encourage hospital administrators to find ways to economize on spending for the hospital stays of Medicare beneficiaries. The incentives would be to shorten stays and expand outpatient activities (which could be billed separately). At the same time, the Health Care Financing Administration implemented the professional review organization (PRO) program, which aimed to reduce unnecessary admissions and to control potential untoward activities under the PPS, such as unnecessary readmissions and dangerously shortened stays. These events, along with some important technological changes, have led to reduced admission rates, shortened stays, and increased use of home care and other outpatient services.

Patterns of care during episodes of illness provide the best opportunity to examine how physicians are responding to various pressures to make less use of the hospital. We investigated another type of episode: the last 90 days of life. Although this period does not represent an episode of illness, it is instructive because of the intense use of health service associated with it[1-3] and because of the emphasis policy makers place on the adequacy of Medicare when beneficiaries need it most.

Few published studies on the nature of death episodes are available. A study by Lubitz[4] on the use and costs of Medicare services in the last 2 years of life reports that decedents comprised 5.9 percent of their study group but accounted for 28 percent of Medicare expenditures; moreover, the study finds that 46 percent of costs in the last year of life are spent in the last 60 days. Work by Riley et al.[4] on the last year of life of Medicare beneficiaries indicates that the cause of death is an important determinant of reimbursement levels. Studies of cancer patients by Greer et al.[6] and Kidder et al.[7] point to strong organizational influences on the use of home and inpatient services in the 50-day period preceding death. For example, in the Greer study, hospice patients

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receiving home care spent about 8 of their last 50 days in hospitals and received about 20 home care visits; hospital-based hospice patients had about twice as much hospital care and half as many home visits. Patients not enrolled in hospice care spent 23 days in the hospital and received about 4 home care visits. Clearly, patterns of care for terminally ill patients are amenable to considerable substitution, and they appear to be readily adaptive to organizational incentives. Hence, we decided to explore how the incentives associated with the PPS have influenced the pattern of care preceding death among Medicare beneficiaries.

METHODS

A simple random sample of 8000 deaths per year for the 1982-1986 period was drawn from the 5 percent Medicare eligibility file. The criteria for inclusion were a valid indicator of the date of death, at least Part A entitlement during the year of death, no indication of enrollment in a Medicare hospice program or health maintenance organization in the year of death, and residence in one of the 50 states or Washington, D.C. A total of 34,669 deaths were studied.

Data on the use of Part A and Part B Medicare services during the 90-day period before death in each case were obtained from paid stay record and billing files. The files contain data on three types of Part A services: inpatient hospitalization (from the MEDPAR files), use of a skilled nursing facility, and use of home health care. The data on Part B services included use of the hospital outpatient department, durable medical equipment (DME), physician inpatient services, and physician ambulatory services. Area variables affecting the health care industry and population characteristics based on county or residence are also amended to the episode files, and beneficiaries' demographic characteristics (date of death, age, race, sex, and location codes) are included.

Dates of admission and discharge from the hospital are recorded precisely, allowing us to note whether a patient died in the hospital. Unfortunately, the files do not indicate where deaths outside the hospital occurred. We know whether the beneficiary used a covered skilled nursing facility (SNF), home health care (HHA), or Part B service in the period before death, but we do not know the exact dates of admission, discharge, or services and thus cannot determine whether the patient was under active care at the time of death. Therefore, we divided the sample into five mutually exclusive and hierarchical groups: (1) beneficiaries who died in the hospital; (2) other beneficiaries whose death was preceded by a skilled nursing facility stay and whose stay occurred after the last hospital discharge in the file; (3) persons who used home health services within 90 days of death but were not included in the two groups described above; (4) of the remainder, persons who had only some Part B or outpatient care; and (5) persons who had no record of use of covered Medicare services within 90 days of death.

In three states -- Kentucky, Ohio, and Pennsylvania -- substantial fractions of bills for inpatient or home health care were unavailable (the bills had been returned to the intermediary for recoding and had not been reentered); these states were dropped from the analysis. In addition, approximately 100 cases with inpatient bills more than 30 days after the date of death were dropped. A total of 34,576 cases were analyzed.

We used econometric analysis, to test our hypotheses about the effects of PPS on trends in Medicare use during the last 90 days of life. A maximum likelihood logit technique was used to estimate three models with discrete dependent variables. The dependent variables in these models were death in the hospital (1 if a person died in the hospital, 0 otherwise), admission to a hospital (1 if a person was admitted within ninety days prior to death, 0 if not), and a Medicare access dummy (1 if a person received no Medicare service within 90 days, 0 otherwise). In a fourth linear model the dependent variable was the number of inpatient days within 90 days before death. In addition, we used several reimbursement amounts as measures of use. Total reimbursements and reimbursements for inpatient care, Part B services, skilled nursing facilities, and home care in real dollars were used as dependent variables in linear regression models to test whether PPS altered reimbursements after 1983. Two types of physician payment models were also tested: payments for services delivered in the hospital and payments for services delivered in ambulatory settings.

We selected several covariates that are generally thought to influence the use of health care services. The first group included variables determining the availability of these services in the region under study (the number of physicians per 100,000 population, the percentage of physicians who are specialists, the number of hospital beds per 100,000 population, and the number of nursing home beds per 100,000 population).

Several variables pertaining to the cases (age, race, sex, and Medicare eligibility status) and regional or county-level demographic variables (percentage of population white, average education level, per capita income, urban/rural location, percentage of population on Part A Medicare, and AAPCC rate, a measure of previous cross-sectional differences in the use and payment levels of the Medicare program) were also included. Use of skilled nursing facilities and home care services within the last 90 days of life were included in the regression on inpatient days in order to test whether these services were used to substitute for inpatient days.

The effect of PPS was estimated by including a PPS dummy (1 in 1984 and after), a non-PPS/PPS state dummy (1 in all years if in non-PPS state), and a set of time (year) dummy variables to capture trends. Since the data set contained both hospitalized and non-hospitalized Medicare beneficiaries, there were no hospital-level data, such as the date each hospital actually phased into the PPS system. It was therefore necessary to assume that in each state where PPS was introduced, the system was implemented at the beginning of calendar year 1984. This specification offers a four-way design to estimate PPS effects and relies on observations in states not under PPS. The PPS coefficient measures the change in states under PPS as compared with other states. The concept is

$$\text{PPS effect} = (\text{PPS}_{post} - \text{PPS}_{pre-} - \text{non-PPS}_{post} - \text{non-PPS}_{pre})$$

where $(\text{PPS}_{pre} - \text{non-PPS}_{pre})$

is given by the coefficient on the non-PPS dummy.

RESULTS

Table 1 shows the demographic features of the Medicare beneficiaries we studied. A gradual increase in longevity was evident across the short period of the study. The average age at death rose from 77.9 in 1982 to 78.5 in 1986. This trend was most pronounced among women, persons in rural areas, persons with end-stage renal disease, and disabled persons. There were smaller improvements in longevity in the other segments of the Medicare population. The table also suggests the effects of an influenza epidemic in 1985. The trend toward increased longevity was slightly reversed that year, and average ages at death fell in all groups except patients with end-stage renal disease.

Some changes in the age-at-death trends may also reflect changes in the ages of covered persons. While the "aged" group is large and stable demographically, one can see from the trend in the group with end-stage renal disease that efforts to extend benefits for patients with this disorder to clinically "marginal" persons have tended to increase the average age of the recipient population. The disabled group has also changed; efforts to limit the eligibility of the "working disabled" have increased the average age of eligible persons.

Hospitalization at the Time of Death

Marked changes in the use of Medicare-covered services over the 1982-1986 period decreased the proportion of deaths occurring in all hospitals from 51.1 percent in 1982 to 45.4 percent in 1986 (Table 2). There was an increase in the proportion of persons who used home care and other Medicare-covered services in the last 90 days of life and a decrease in the proportion who used no Medicare-covered services. This latter trend may reflect an improvement in access to these services during the last 90 days of life.

Table 3 shows trends in the fractions of in-hospital deaths in states with and without PPS and in various segments of the Medicare population. The reduction was largest among white, 75 to 84-year-old, and rural subjects. Clear differences in the

Table 1. Characteristics of the Study Population

	1982	1983	1984	1985	1986
Number of cases	6947	6962	6889	6915	6863
Average age at death	77.92	78.12	78.49	78.31	78.49
Percent < 70	19.45	19.20	18.77	18.66	17.78
70-74	16.94	16.40	16.10	16.69	16.44
75-79	18.27	17.85	18.86	18.08	18.45
79-84	17.72	18.41	16.98	17.93	18.43
85-89	15.43	15.15	14.69	14.71	15.21
≤90	12.19	12.97	14.60	13.97	13.70
Percent female	49.33	48.95	50.54	50.56	49.75
Average age of women	79.90	80.21	80.82	80.60	80.80
Average age of men	76.00	76.11	76.10	75.96	76.21
Percent nonwhite	10.23	10.70	10.03	10.85	11.67
Average age of nonwhites	75.67	75.84	76.15	75.87	76.17
Average age of whites	78.18	78.39	78.75	78.60	78.80
Percent aged	96.08	95.50	95.66	95.03	94.30
Average age of aged	79.00	79.26	79.57	79.55	79.83
Percent disabled	3.57	4.11	4.08	4.66	5.09
Average age of disabled	52.49	54.53	55.23	54.90	56.73
Percent with ESRD*	0.92	1.03	0.87	1.08	1.31
Average age of subjects with ESRD*	60.37	62.72	64.16	65.84	64.65
Percent urban residents	69.30	69.97	70.68	68.40	67.55
Average age of urban residents	78.04	78.14	78.44	78.23	78.45
Average age of rural residents	77.65	78.07	78.62	78.46	78.58

*ESRD denotes end-stage renal disease.

Table 2. Medicare Provider at the Time of Death.

	1982	1983	1984	1985	1986
			% of subjects		
Death in hospital	51.1	50.7	46.7	44.6	45.4
Death preceded by SNF services*	1.9	1.7	2.2	2.2	2.0
Death preceded by home care services	6.2	6.8	8.3	9.3	9.7
Death preceded by other Part B services	31.5	31.3	33.7	35.9	34.7
No Medicare services in 90 days before death	9.3	9.6	9.1	8.0	8.2

*SNF denotes skilled nursing facility.

Table 3.

Percentage of Deaths Occuring in the Hospital.

	1982	1983	1984	1985	1986
PPS Status					
States not under PPS	53.8	53.7	55.3	49.9	50.7
States under PPS	50.5	49.9	44.7	43.4	44.2
Race					
White	50.7	49.7	46.1	43.6	44.7
Nonwhite	52.2	54.2	51.1	50.2	48.0
Age					
<65	40.4	45.6	43.7	42.0	41.9
65-74	54.7	52.9	49.1	49.1	48.0
75-84	56.5	55.1	49.7	47.8	48.3
≥85	42.5	43.6	41.5	36.3	39.7
Sex					
Male	50.6	50.8	46.8	43.8	44.9
Female	51.6	50.5	46.8	45.3	45.9
Location					
Rural	54.0	51.8	45.7	44.6	45.5
Urban	49.8	50.0	47.3	44.6	45.3

levels of in-hospital deaths were associated with race and age; beneficiaries who were white and those over 85 were less likely to die in the hospital. Differences between urban and rural beneficiaries were no longer present by 1986.

The observed reduction in the fraction of deaths occurring in the hospital appears large (about 10 percent) for such a short period. To give a better idea of the trend, Figure 1 shows the quarterly rates of in-hospital deaths (as a fraction of all deaths among Medicare beneficiaries) in states with and without PPS. In 1982 and 1983 the fraction of in-hospital deaths was roughly 10 percent higher in the states without PPS. The gap clearly widened during the next few years, as in-hospital mortality rapidly declined in states under PPS. Some decline was evident in the other states. These patterns reflect the more rapid shortening of length of stay in states under PPS.

Table 4 indicates that the decrease in deaths occurring in hospitals was accompanied by slightly lower admission rates, shorter stays, and lower rates of death before discharge. Admission rates did not change very much; in 1986 about two thirds of Medicare beneficiaries were still admitted at least once during the last 90 days of life. Days of hospital care, on the other hand, fell 8 to 10 percent over the five years of the study; the reduction occurred between 1983 and 1985.

Data on the hospital stays of these patients indicated a substantial reduction in the fraction who died before discharge and an increase in the fraction who died within 15 days after discharge (Table 4). There was little change in the rate of death in the period 15 to 30 days after discharge and a slight increase in the rate 15 days after admission. These data suggest an increase in the severity of illness at the time of admission and an increase in the numbers of terminally ill patients being discharged earlier, to die outside the hospital within several weeks. Although overall hospital admission rates among patients on Medicare fell markedly over the period of the study, (from about 381 per one thousand persons in 1982 to about 310 per thousand in 1986), it does *not* seem that beneficiaries had much less access (lower admissions) during the last 90 days of life.

Figure 1. In-Hospital Mortality in States with and without PPS.

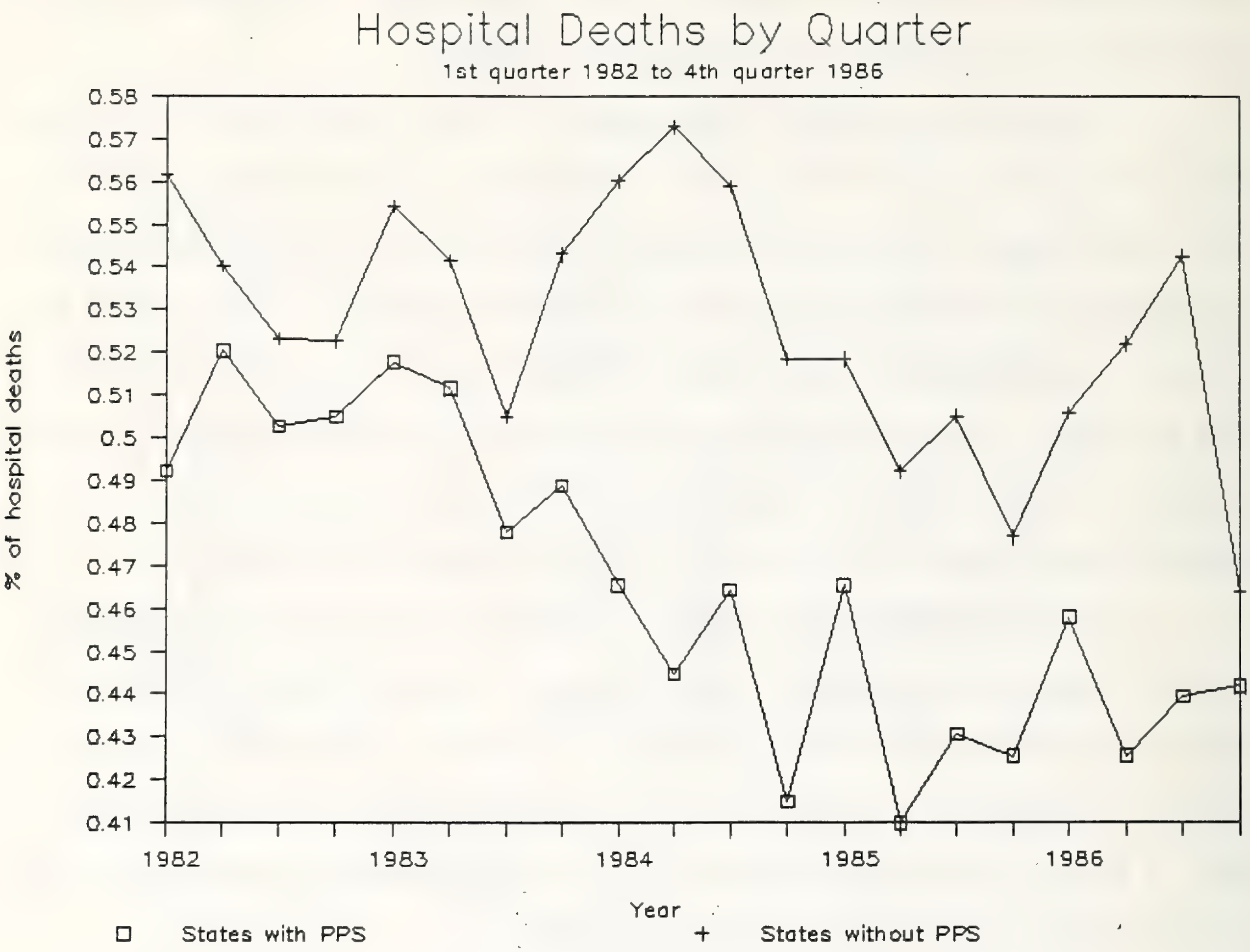

Table 4

Hospital Use and Mortality Rates among Hospitalized Persons.

	1982	1983	1984	1985	1986
Admission rates	67.5	68.2	66.3	65.4	66.0
Days of hospital care	13.2	12.9	11.8	10.8	10.9
Percent of hospitalized persons:					
Dead at discharge	75.7	74.3	70.5	68.2	68.8
Dead 1-15 days after discharge	10.9	10.9	13.4	14.6	13.8
Dead 1-30 days after discharge	16.3	16.7	19.9	21.0	20.7
Dead 1-15 days after admission	51.2	52.6	53.1	53.9	53.8

Use of Home Care and Skilled Nursing Facilities

Use of the home care benefit during the last 90 days of life rose markedly over the five years of the study (from 13.9 percent to 18.8 percent (Table 5)). Home care use during the 90-day period also rose among persons who were hospitalized, suggesting a general increase in use; the fraction of hospital discharges receiving HHA care is up from 17% to 23%. Although HHA use rates increased in all demographic and age groups studied, the trend was most pronounced in groups whose rates were lowest initially, suggesting greater convergence across the program. The largest increases occurred in states under PPS, in rural areas, and in the 75 to 84-year-old age group. The smaller increase among persons over 85 may be associated with the fact that many people in this age group reside in long-term care facilities, where health care services are available.

Use of skilled nursing facilities was subject to a trend, although it was less marked than the trend for home care services, and there was an actual drop in use rates in the last year of the study. About 6 percent of subjects used in a skilled nursing facility during the last 90 days of life. As with the use of home care, use of this benefit increased among persons who were also hospitalized during the last 90 days of life. Use in urban areas and states not under PPS and use among younger beneficiaries did not increase very much, if at all. Increases were seen in rural areas and states under PPS and among beneficiaries over age 85, but rates were not stable enough to indicate a break in trends after PPS was introduced.

The mix of Part A services has changed for beneficiaries in the last 90 days of life. Table 6 shows the decline in the fraction of persons using only hospital services and the increase in the use of the hospital/home care combination. There was no substantial change in the fraction of persons using no Part A services in the last 90 days of life.

The frequency of death preceeded by no Medicare service use may be marker for poor access. Rates of death preceded by no Part A or Part B services during the last 90 days have generally declined (Table 7), but this improvement in access was evident only in states under PPS. In these states, the fraction of patients dying with no Medicare

Table 5. Home Care Visits and Use of Skilled Nursing Facilities in the Last 90 Days of Life.

	1982	1983	1984	1985	1986
			% of subjects		
Home care					
Total	13.9	14.9	17.3	18.5	18.8
Total discharged *	17.3	18.3	21.9	23.4	24.0
Under PPS	13.2	14.1	17.4	18.7	18.7
Not under PPS	17.2	18.3	17.0	17.6	19.5
Rural	12.0	13.5	15.0	17.7	17.8
Urban	14.8	15.4	18.3	18.9	19.3
<65	11.4	14.0	18.2	20.9	15.8
65-74	14.5	15.8	19.1	21.4	19.8
75-84	15.8	15.5	18.7	20.1	22.5
≥85	11.4	13.3	13.6	12.9	13.9
Skilled nursing					
Total	5.7	6.0	6.4	6.5	6.2
Total discharged *	6.9	7.8	8.3	8.7	8.2
Under PPS	6.0	6.6	7.0	7.1	6.6
Not under PPS	4.1	3.4	3.8	3.9	3.9
Rural	3.8	4.6	5.3	6.4	5.7
Urban	6.5	6.5	6.9	6.5	6.4
<65	2.5	1.9	2.8	3.1	2.0
65-74	4.3	4.4	4.6	3.7	4.3
75-84	5.9	6.7	7.2	7.3	6.3
≥85	7.5	7.7	8.0	9.0	8.7

*Percentage of persons with hospital discharge who also received home care visits or stayed in a skilled nursing facility during the 90 days.

Table 6. Use of Part A Medicare Services in the Last 90 Days of Life.

Provider*	1982	1983	1984	1985	1986
			% of subjects		
Hospital only	51.9	51.5	47.6	45.8	46.0
Home care only	2.2	2.4	2.7	3.1	3.0
SNF only	1.0	0.7	0.8	0.7	0.7
Hospital and home care, no SNF	11.0	11.4	13.2	14.0	14.6
Hospital and SNF, no home care	3.9	4.2	4.2	4.3	4.2
Hospital, home care, and SNF	0.7	1.1	1.3	1.3	1.2
Home care and SNF, no hospital	0.1	0.0	0.1	0.1	0.1

*SNF denotes skilled nursing facility.

Table 7

Death With No Prior Medicare Use
(in % of total)

	1982	1983	1984	1985	1986
Total	9.3	9.6	9.1	8.0	8.2
PPS Status					
States not under PPR	8.0	7.8	7.6	7.4	8.0
States under PPS	9.6	10.0	9.5	8.1	8.2
Race					
White	9.1	9.4	8.9	8.0	8.2
Non-white	12.0	11.9	11.4	8.2	8.9
Age					
<65	23.7	20.5	22.5	20.1	18.5
65-75	10.1	11.9	11.3	10.0	11.9
75-85	6.5	6.1	6.7	5.7	5.2
>85	8.9	9.2	7.3	6.4	6.2
Sex					
Male	11.4	11.3	12.0	10.1	10.1
Female	7.2	7.7	6.3	5.9	6.2
Location					
Rural	9.1	9.8	9.4	7.9	8.2
Urban	9.4	9.5	9.0	8.1	8.1

services dropped from 9.6 to 8.2 percent, whereas it remained at 8.0 percent in states without PPS. The favorable trend was most pronounced among nonwhites (the fraction fell from 12.0 to 8.9 percent in this group, as compared with 9.1 to 8.2 percent among whites) and beneficiaries over 85. Interestingly, women were much more likely than men to use some service before death; in 1986, 10.1 percent of the men received no services, as compared with 6.2 percent of the women.

Medicare Reimbursements in the Death Episode

Table 8 shows that Medicare payments for both hospital and Part B services in the last 90 days of life have fallen slightly in real terms. In 1979 dollars, Medicare payments decreased from $3,600 to less than $3,400 over the period from 1982 to 1986. Generally, the composition of reimbursements was stable; hospital reimbursements represented a little more than 75 percent of all payments for care during the last 90 days of life, and Part B payments represented about 18 percent. However, payments for home care and physicians' ambulatory services both increased their share of reimbursements by about 50 percent. Reimbursements for home care represented 2.3 percent of the total in 1986 and 1.6 percent in 1982. Reimbursements for physicians' ambulatory care represented 1.5 percent of payments in 1986 and 1.0 percent in 1982. Payments for DME and other Part B services increased at a similar rate, also from very low base levels.

Table 8 also shows that states under PPS had larger real declines in total payments and payments for inpatient care, with smaller declines in Part B payments, relative to other states. Costs were also higher for persons in urban areas and persons who died at younger ages.

Table 9 shows reimbursements during the last 90 days of life for persons according to the provider-at-death categories we defined earlier in the paper) see Table 2). Real spending is down for all groups, with total Medicare reimbursements for persons who died in hospitals, skilled nursing facilities, and under home health agency care, declining by 2 percent, 4 percent and 12 percent, respectively. For persons who died in

Table 8. Medicare Reimbursement for Services Used in the Last 90 Days of Life

	1982	1983	1984	1985	1986	1981	1982	1983	1984	1985	1986
	Mean dollars per person* (in 1979 Dollars)					Nominal dollars per person					
All reimbursement											
Total	3615.7	3720.9	3650.0	3514.6	3366.1	4047.4	4982.4	5573.9	5796.2	5918.6	6281.1
Without PPS	3757.0	4018.6	4284.1	3852.5	3594.6	3859.0	5177.2	6019.8	6803.1	6487.6	6707.5
With PPS	3584.3	3650.2	3498.7	3439.4	3314.9	4092.9	4939.1	5468.0	5555.9	5791.9	6185.6
Rural	3036.5	2959.3	2882.4	2798.9	2761.0	3252.1	4184.3	4433.0	4577.2	4713.4	5152.1
Urban	3854.1	4029.5	3972.2	3846.6	3651.7	4370.8	5310.9	6036.2	6307.8	6477.7	6814.1
<65	3695.6	3964.3	3942.2	3991.2	3924.5	4717.9	5092.6	5938.5	6260.2	6721.1	7323.2
65-75	4106.5	4290.3	4214.6	4134.7	3693.7	4665.8	5658.7	6426.9	6692.8	6962.8	6892.5
75-85	3899.9	4045.3	3816.2	3659.6	3583.2	4195.3	5374.1	6059.9	6060.1	6162.8	6686.3
>85	2691.5	2651.9	2825.9	2593.9	2648.1	2948.2	3708.9	3972.5	4487.6	4368.1	4941.3
Part B reimbursement											
Total	641.4	649.1	665.2	652.3	596.0	783.5	883.8	972.3	1056.4	1098.4	1112.2
Percent of total	17.7	17.4	18.2	18.5	17.7						
Without PPS	698.5	726.5	781.8	754.0	587.5	809.6	962.6	1088.3	1241.5	1269.8	1096.3
With PPS	628.6	630.7	637.4	629.6	598.0	777.2	866.2	944.8	1012.2	1060.2	1115.8
Rural	506.2	500.9	498.9	494.0	471.5	571.5	697.5	750.3	792.2	831.9	879.9
Urban	699.3	711.1	734.4	725.8	655.6	871.6	963.7	1065.3	1166.3	1222.3	1223.4
<65	711.3	768.9	774.1	732.6	760.6	957.4	980.2	1151.8	1229.3	1233.7	1419.3
65-75	792.8	766.5	798.0	824.4	679.7	950.1	1092.5	1148.2	1267.3	1388.3	1268.3
75-85	664.0	698.4	693.1	665.4	648.1	788.3	915.0	1046.2	1100.6	1120.5	1209.3
>85	430.6	436.1	477.3	441.2	412.6	536.0	593.4	653.3	757.9	742.9	770.0
Inpatient reimbursement											
Total	2780.6	2872.2	2770.8	2642.8	2560.4	3058.1	3831.7	4302.6	4400.0	4450.5	4777.7
Percent of total	76.9	77.2	75.9	75.2	76.0						
Without PPS	2848.7	3111.2	3304.4	2902.4	2812.8	2839.7	3925.5	4660.6	5247.4	4887.7	5248.6
With PPS	2765.5	2815.5	2643.4	2585.0	2503.9	3110.9	3810.9	4217.6	4197.7	4353.1	4672.3
Rural	2385.3	2313.4	2213.7	2128.2	2098.3	2530.0	3287.0	3465.4	3515.3	3583.9	3915.5
Urban	2939.6	3095.2	3005.2	2881.7	2778.0	3269.6	4050.8	4636.6	4772.3	4852.7	5183.7
<65	2647.5	2888.8	2866.8	2943.9	2883.0	3449.1	3648.3	4327.4	4552.5	4957.6	5379.6
65-75	3110.9	3301.9	3175.6	3063.0	2783.9	3493.1	4286.8	4946.2	5042.8	5158.1	5194.7
75-85	3046.6	3150.6	2906.6	2769.2	2709.7	3192.3	4198.2	4719.6	4615.7	4663.4	5056.3
>85	2104.0	2059.0	2181.7	1987.6	2080.9	2264.8	2899.3	3084.4	3464.6	3347.2	3882.9
SNF reimbursement ‡	48.1	46.3	44.8	42.5	38.0	55.1	66.3	69.3	71.2	71.6	70.9
Home care reimbursement	57.8	59.6	75.6	82.6	75.8	55.6	79.6	89.3	120.1	139.1	141.4
Part B inpatient MD reimbursement	521.7	524.5	510.3	477.1	426.3	643.2	718.9	785.7	810.3	803.5	795.5
Part B office MD reimbursement	37.1	37.2	43.7	50.0	52.1	46.1	51.1	55.8	69.4	84.2	97.2
Part B DME reimbursement	29.2	32.8	48.1	49.0	45.0	32.6	40.2	49.2	76.4	82.5	84.0
Other Part B reimbursement	53.4	54.4	63.2	76.1	72.6	61.6	73.6	81.5	100.3	128.1	135.5

* Calculated with Data Resources, Inc. price indexes for medical care services.

‡ SNF denotes skilled nursing facility.

Table 9

Resource Use in the Last 90 Days of Life

(Means, in 1979 dollars per person)[1]

	Medicare Provider at Death									
	Hospital		SNF		HHA		Other[2]		No Medicare Services	
	1982	1986	1982	1986	1982	1986	1982	1986	1982	1986
Total Reimbursements	5321.4	5212.8	3945.0	3793.4	4049.8	3605.0	1815.3	1655.5	0.0	0.0
Part B Reimbursements	908.1	854.2	656.8	683.6	651.6	637.1	395.7	382.8	0.0	0.0
Inpatient Reimbursements	4252.0	4159.8	2062.1	2198.2	2743.8	2415.0	1268.3	1136.1	0.0	0.0
SNF Reimbursements	20.3	20.6	1114.3	704.3	35.0	28.9	46.1	33.9	0.0	0.0
HHA Reimbursements	53.7	75.7	26.1	67.9	484.2	412.6	0.0	0.0	0.0	0.0
Part B Inpatient MD Reimbursements	771.5	657.8	533.5	430.5	436.9	390.9	286.9	234.1	0.0	0.0
Part B Office MD Reimbursements	41.0	64.2	45.0	62.0	43.2	57.0	40.0	46.6	0.0	0.0
Part B DME Reimbursements	33.1	46.0	19.2	55.4	94.8	99.4	19.2	38.4	0.0	0.0
Part B Other Reimbursements	62.4	86.2	59.1	135.7	76.6	89.8	49.7	63.5	0.0	0.0

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[1] Calculated using DRI medical care services price indexes.

[2] Includes Part B, Inpatient or Outpatient Care.

hospitals, Part B and inpatient reimbursements decreased while SNF and HHA reimbursements increased. For persons who used SNFs, a 58% decrease in SNF reimbursements offset increases in Part B, inpatient, and HHA reimbursements. For persons who died under HHA care, reimbursements decreased overall for Part B services as well as each of the Part A services. As would be expected, this table also shows that the Medicare provider at the time of death receives a disproportionate amount of reimbursement (i.e., inpatient reimbursements are greatest for persons who die in hospitals; SNF reimbursements are greatest for persons who die in SNFs; and HHA reimbursements are greatest for those who die under HHA care).

Statistical Findings

Table 10 lists PPS coefficient estimates and their t-values for all the models. (A list of parameter estimates is in the Appendix.) As the table shows, the number of inpatient days during the last 90 days of life decreased after PPS; we estimated a reduction of 1.5 days (13 percent) of inpatient care in the 90-day period before death. The introduction of PPS was not consistently associated with a lowered probability of death in the hospital (p=.009). Admission rates also fell after PPS, but not significantly so (p=.41). Consequently, we conclude that the trend in reduction in deaths occurring in hospitals was associated with PPS, and that reduction was due to lower lengths of stay rather than reduced admission rates.

In the hospital death and admission models there are strong supply influences. Hospital bed availability increases both the likelihood of admission, and death in the hospital. Physician availability and nursing home bed availability suggest substitution for hospital care, tending to reduce the likelihood of admission and death in the hospital.

Most of the PPS coefficient estimates in reimbursement regressions turned out to be insignificant. Changes in total spending, spending for inpatient care, and spending for skilled nursing facilities were not associated with the introduction of PPS. But, spending for home care increased after PPS by about 28 percent. We suspect that the

Table 10. Results Obtained with the Regression Models

		PPS Coefficient		
Measure	Mean	OLS PPS Coefficient	Logit Coefficient	p-Value
Death in hospital dummy#	0.48		-0.149	.009
Hospital admission dummy#	0.67		-0.050	.411
No Medicare use dummy#	0.09		-0.108	.301
Number of inpatient days in 90 days before Death	11.41	-1.559		.0001
Total reimbursement ‡	3569.7	21.991		.861
Inpatient reimbursement ‡	2721.7	-42.646		.690
Total Part B reimbursement ‡	640.7	38.295		.143
SNF reimbursement ‡	44.11	3.757		.601
Home care reimbursement ‡	70.11	19.269		.005
Part B inpatient MD reimbursement ‡	492.10	18.047		.459
Part B office MD reimbursement ‡	43.90	7.771		.004

* The complete list of estimates is in the Appendix.

‡ In 1979 dollars, calculated with Data Resources, Inc. prices indexes for medical care services.

# Coefficient was estimated using a linear logit model.

capacity constraints on expanded use of skilled nursing facilities were more severe than those on home care services, resulting in less measured substitution between skilled nursing facilities and hospital care over the short observational period.

The level of Part B activities seems to have been influenced by PPS, suggesting substitution of outpatient for inpatient care. Physician office reimbursements rose about 20 percent after PPS was introduced. Total Part B payments and inpatient Part B reimbursements (mainly physician payments) had fairly large positive coefficients (4 to 6 percent of the respective means) but were not statistically significant.

In this analysis, the introduction of PPS did not appear to have altered the likelihood of persons receiving some (or no) Medicare-covered service during the last 90 days of life; the OLS and logit coefficients suggest a reduction in the fraction not using services, but the standard errors are large.

The models show that there were some important base-line differences between states where PPS was waived and states where it was implemented. Hospital admission rates were similar, but states where PPS was waived had more days of hospital care and offered a greater likelihood of death in a hospital. These states also had lower base-line levels of reimbursement for skilled nursing facilities and higher levels of reimbursement for care in a physician's office. This pattern is consistent with other studies showing longer lengths of stay and higher inpatient mortality in New York and New Jersey, where shortages of nursing home beds are pervasive.[11]

The availability of health services has an important influence on use and spending. The number of nursing home beds per capita had a negative and significant effect ($p < 0.01$) on most reimbursement models, suggesting that nursing homes are a general community substitute for other forms of non-hospital care. More beds seemed to lead to lower reimbursements for skilled nursing facilities, suggesting competition rather than supply inducement, but did not seem to influence hospitalization rates. Interestingly, the indicators for the use of skilled nursing facilities (and home care) in the days-of-care regression did not show substitution of skilled nursing facilities and hospitals; it appears that these covariates are proxies for severity, showing more hospital days for persons also receiving these other types of care.

The availability of hospital beds, on the other hand, tended to be positively associated with days of care (as found by Ginsgerg and Koretz[12]) but, negatively associated with most reimbursement measures. This would suggest the substitution of days-of-care for care in a skilled nursing facility, home care, physicians' services, and other services. Interestingly, inpatient payments were also lower when more beds were available, suggesting competitive influences rather than supply inducement. The number of physicians per capita, on the other hand, was associated with lower admission rates, fewer days of care, lower in-hospital death rates, and higher levels of reimbursement for every category studied, including physician payments. This suggests substitution against hospitals but the absence of competition in medical markets.

Age was significant in all the regressions except for the hospital admission rates model. Although its effects of lowering the probability of hospital admission and death in the hospital and of reducing the number of inpatient days were small, the estimates in reimbursement models were not. Older beneficiaries, holding other variables constant, received less inpatient, Part B, and home care.

CONCLUSIONS

Our results indicate that PPS has quickened the downward trend in the number of Medicare beneficiaries who die in the hospital, mainly through effects on the average length of stay. Although the last 90 days of life, involved fewer days of inpatient care, general access to covered services and hospital admission rates did not decline. Indeed, it appears that PPS has simply led to more frequent discharge of dying patients to the home environment, with accompanying physician, DME, and home care services. These results are similar to but not as pronounced as those reported by Greer et al.[6] among terminally patients exposed to hospice programming. The exception is that physician services appeared as a substitute for inpatient care in our sample, whereas Greer et al.

found a complementary relationship between the two types of care among the terminally ill.

These general associations between PPS and patterns of practice in the 90 days before death represent important alterations in the way Medicare benefits are being used in the final stages of life. The observed changes are consistent with general PPS incentives to lessen inpatient care. It is not possible to say whether these changes improve or reduce the quality of the services delivered to Medicare beneficiaries, but certainly this issue deserves to be studied.

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Appendix

Estimation Results

	Death in Hospital Rate (a)	Hospital Admission Rate (a)	No Medicare Serv. in 90 Days Rate (a)	Days of Hospital Care in 90 Days	Total Reimbursements in 90 Days (b)
Mean	0.478	0.667	0.088	11.412	3569.716
Covariates:					
Year 1983 (1 if 1983)	-0.018	0.033	0.040	-0.550 **	82.859
Year 1984 (1 if 1984)	-0.043	-0.010	0.091	-0.519	-41.467
Year 1985 (1 if 1985)	-0.142 **	-0.064	-0.058	-1.738 ***	-264.317 **
Year 1986 (1 if 1986)	-0.095	-0.034	-0.028	-1.580 ***	-391.110 ***
PPS (1 if PPS year and non-waiv)	-0.149 ***	-0.050	-0.108	-1.559 ***	21.991
Waivered state (1 if waivered)	0.235 ***	0.050	-0.190 **	2.463 ***	-112.213
SNF use (1 if used SNF)	-	-	-	8.311 ***	-
HHA use (1 if used HHA)	-	-	-	7.266 ***	-
Beneficiary's age	-0.018 ***	-0.011 ***	-0.025	-0.129 ***	-59.661 ***
Beneficiary's sex (1=male)	-0.075 ***	-0.055 **	0.421	-0.348 **	-16.010
Race (1=white)	-0.242 ***	-0.251 ***	0.027	-1.204 ***	-399.947 ***
Urban/rural (1 if urban county)	-0.014	-0.063 **	0.022	-0.382 *	170.288 **
Aged status (1 if aged)	0.754 ***	0.751 ***	-0.539 ***	3.541 ***	1604.572 ***
ESRD (1 if ESRD)	0.878 ***	1.083 ***	-1.734 ***	7.427 ***	6078.698 ***
Hosp Beds/100,000	0.0003 ***	0.0002 ***	0.0001	0.00158 ***	-0.42951 ***
Median school completed (county)	-0.110 ***	-0.091 ***	0.000	-0.358 **	-38.978
% of doctors who are specialists	-0.001	-0.001	-0.001	0.001	-0.851
Patient care doctors/100,000	-0.001 ***	-0.001 ***	0.000 *	-0.005 ***	0.938 ***
% of white population (county)	0.001	0.000	-0.001	-0.016 **	-1.483
% of population on Part A	0.001	0.005	-0.014 **	0.018	10.969
APCC rate, Part A	0.002 ***	0.003 ***	-0.002 **	0.028 ***	22.040 ***
Nursing home beds/100,000	0.000	0.000	0.000	0.000	-0.086
R-Square	-	-	-	0.079 ***	0.064 ***

*** significant at the 1% level
** significant at the 5% level
* significant at the 10% level

(a) Coefficients were estimated using a linear logit model
(b) In 1979 dollars, using DRI medical care services price indexes

Appendix (cont'd)

Estimation Results
Reimbursement Amount Regression Models

	Total Part B Reimb. (a)	Total Inpatient Reimb. (a)	SNF Reimb. (a)	HHA Reimb. (a)	Part B MD Inpatient Reimb. (a)	Part B MD Office Reimb. (a)
Mean	640.728	2721.717	44.110	70.113	492.101	43.900
Covariates:						
Year 1983 (1 if 1983)	2.962	76.197	-1.941	1.499	-0.682	-0.345
Year 1984 (1 if 1984)	-18.328	-19.082	-8.110	1.087	-34.185	-0.618
Year 1985 (1 if 1985)	-47.766 *	-210.502 *	-10.944	6.423	-80.946 ***	5.184 *
Year 1986 (1 if 1986)	-100.064 ***	-272.931 **	-15.107 **	-0.403	-128.519 ***	7.189 ***
PPS (1 if PPS year and non-waiv)	38.295	-42.646	3.757	19.369 ***	18.047	7.771 ***
Waivered state (1 if waivered)	-6.623	-73.594	-25.208 ***	5.674	6.896	3.366
Beneficiary's age	-13.740 ***	-43.377 ***	1.081 ***	-1.135 ***	-11.745 ***	-0.514 ***
Beneficiary's sex (1=male)	13.568	-11.984	-9.107 ***	-9.839 ***	14.415	-0.150
Race (1=white)	7.031	-363.056 ***	2.846	-23.715 ***	-0.698	7.156 ***
Urban/rural (1 if urban county)	53.476 ***	108.899 *	4.305	-1.389	35.827 ***	7.262 ***
Aged status (1 if aged)	339.327 ***	1185.022 ***	2.123	33.508 ***	292.278 ***	20.908 ***
ESRD (1 if ESRD)	1522.577 ***	2962.455 ***	-10.526	-20.693	1145.426 ***	113.468 ***
Hosp Beds/100,000	-0.160 ***	-0.231 **	-0.010	-0.022 ***	-0.099 ***	-0.026 ***
Median school completed (county)	-8.400	-24.635	2.570	-9.288 ***	-1.866	0.215
% of doctors who are specialists	0.055	-1.055	0.111	0.145 **	-0.148	0.030
Patient care doctors/100,000	0.263 ***	0.556 **	0.045 ***	0.046 ***	0.180 ***	0.045 ***
% of white population (county)	-0.247	-1.608	0.152	-0.208 *	-0.619	-0.108 **
% of population on Part A	6.820 ***	3.313	-0.005	1.140 ***	5.693 ***	0.799 ***
AAPCC rate, Part A	3.860 ***	17.157 ***	0.265 ***	0.253 ***	3.215 ***	0.151 ***
Nursing home beds/100,000	-0.069 ***	0.013	-0.006 *	-0.022 ***	-0.061 ***	-0.005 ***
R-Square	0.071 ***	0.043 ***	0.007 ***	0.010 ***	0.055 ***	0.036 ***

*** significant at the 1% level
** significant at the 5% level
* significant at the 10% level

(a) In 1979 dollars, using DRI medical care services price indexes

HOSPITAL ADMISSIONS

PHC SYNTHESIS

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HOSPITAL USE TRENDS

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PROGRAM STATISTICS ON TRENDS IN HOSPITAL UTILIZATION

Working Paper

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October 24, 1988

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Introduction

Hospital utilization in the Medicare program has changed markedly in the 1980s, most likely due to the introduction of PPS and technological changes in medical care. This short paper summarizes these changes. We examine trends over the 1981-1986 period in:

- length of stay, including a measure of casemix adjusted length of stay,
- days of care per capita (eligible beneficiary), and
- admission rates per capita (eligible beneficiary).

Our objective is to describe the differences in hospital use trends across different types of hospitals and across the 50 states. Modeling of days of care and admission rates and associated hypothesis testing are forthcoming in a paper that uses the BEAA quarter as the unit of observation.

Data and Methods

Data are taken from HCFA's 20% sample file of stay records (MEDPAR). A hospital year file was made by aggregating measures to the hospital level. For each hospital year we computed expected days of care based upon assigned DRGs and 1985 length of stay weights. DRG adjusted length of stay for each hospital per year was computed as:

$$\text{ADJLOS}_k = \text{OBS LOS}_k \times \frac{\text{NATLOS}^{w}_{81,\,j}}{\text{EXPLOS}^{w}_{j}}$$

where,

w = use of national length of stay weights (per DRG)
k = all Medicare cases
j = all Medicare cases assigned to DRGs with weights
EXPLOS = Expected LOS using National Average DRG weights
$\text{NATLOS}^{w}_{81,j}$ = constant for nation for Quarter 1, 1981 = 8.4896

This procedure deflates observed lengths of stay for the observed mix of cases, where the deflator is based on Quarter 1, 1981. Measured differences in adjusted LOS over time and between hospitals will reflect differences in stay lengths, with differences in DRG mix removed by the deflator. As with any deflator, the choice of base year (and weights) is arbitrary. The resulting series of adjusted lengths of stay, when compared to observed lengths of stay, will index the changes in stay length policy, net of DRG mix differences. Readers are cautioned that upcoding tendencies in patient classification are not removed by this standardization procedure. If this bias exists,[1] then the difference between observed and adjusted LOS overstate the true difference.

The per capita measures we examined are derived from a file that uses the BEAA per year as the unit of observation. These geographic areas of commerce each are centered around an urban area (often an MSA). They were developed by the Bureau of Economic Analysis for regional economic studies and modified slightly by us to result in 187 areas. Each area was split into an urban and rural component on which Medicare use was aggregated based on the beneficiary's residence. Data from HCFA's eligibility files were used to get beneficiary counts to use as denominators.

General Use of Hospitals

Table 1 indicates the general trends that occurred in the use of short term general hospital care in the Medicare program. We examined only days of care and admission rates, leaving LOS to the next section. Obviously, days of care, admissions, and LOS form an identity:

$$\frac{\text{DAYS}}{\text{CAPITA}} = \frac{\text{ADMITS}}{\text{CAPITA}} \times \frac{\text{DAYS}}{\text{ADMIT}}.$$

Hospital admissions per beneficiary decreased from .355 to .309 over the six year period, about a ten percent decrease since 1983. Admission rates decreased in both urban and rural locations, from 33.3 per 100 to 29.7 per 100 in urban areas and from 40.9 per 100 to 33.9 per 100 in rural areas. In percentage terms, rural beneficiary admission rates decreased one and one half times as urban beneficiary admission rates, and converged in the direction of rates seen in urban areas.

Days of care decreased faster than admissions due to reductions in stay lengths as well as admissions. Days per 100 beneficiaries decreased from 367.8 days to 260.2 days nationally. The reduction in rural areas was larger than in urban areas; days per 100 beneficiaries decreased from 374.6 days to 252.3 days in rural locations, and from 365 days to 263.7 days in urban locations.

Figure 1 shows the relationship between days of care and admission rates graphically. All graphs plot percentage changes against the 1981 level (which is 1.0 on

---

[1] Carter, G.M. and Ginsburg, P.B., The Medicare Casemix Index Increase: Medical Practice Changes, Aging and DRG Creep, Santa Monica, CA: Rand Corporation, 1985.

Table 1

Hospital Days per Enrollee

	1981	1982	1983	1984	1985	1986	Pre/Post* % Change
Urban	3.650	3.878	3.778	3.239	2.868	2.637	-0.227
Rural	3.746	3.925	3.783	3.074	2.671	2.523	-0.278
Overall	3.678	3.891	3.779	3.191	2.810	2.602	-0.242

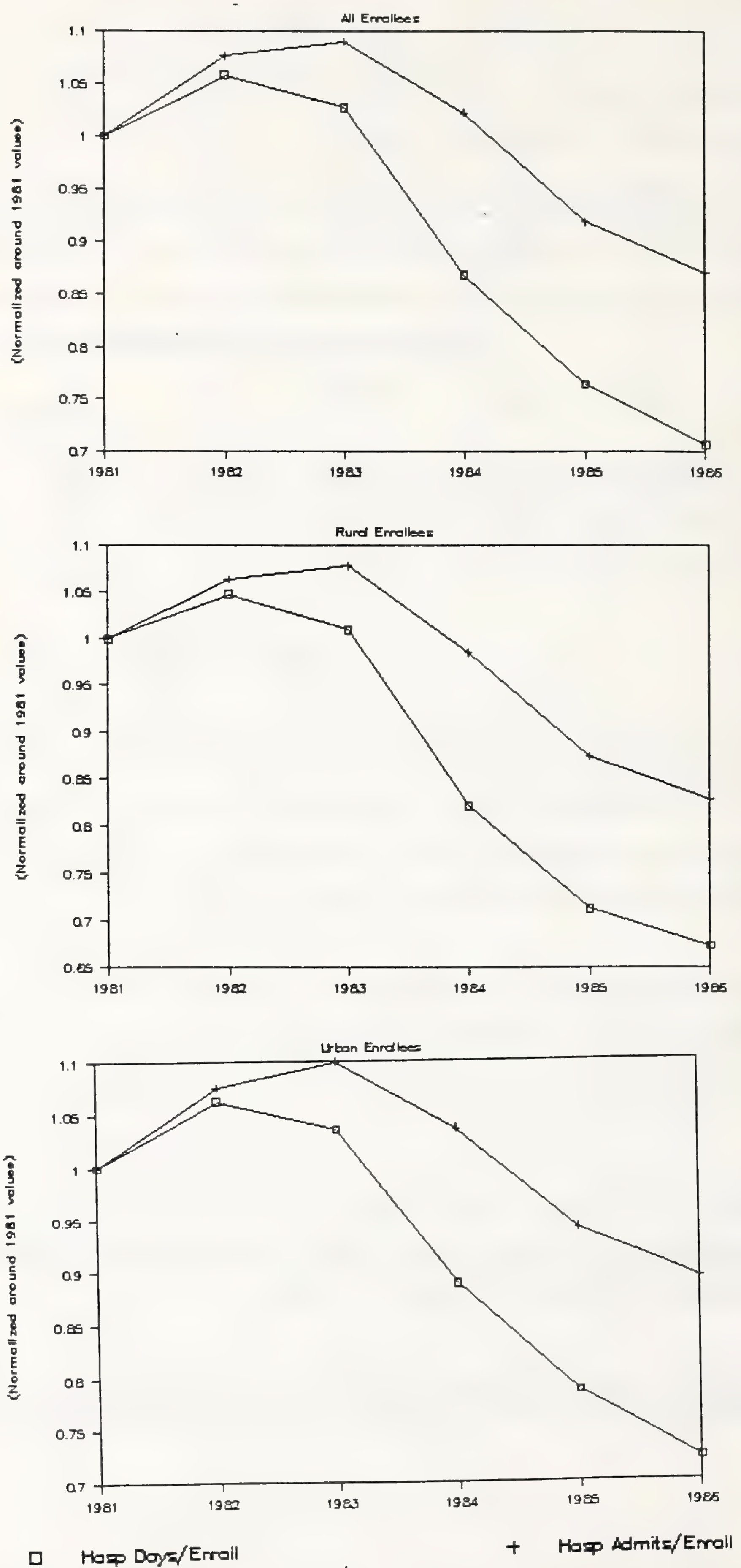
Admissions per Enrollee

	1981	1982	1983	1984	1985	1986	Pre/Post* % Change
Urban	0.333	0.358	0.366	0.345	0.313	0.297	-0.096
Rural	0.409	0.435	0.441	0.403	0.357	0.339	-0.145
Overall	0.355	0.382	0.387	0.363	0.326	0.309	-0.112

*Computed as the difference in mean before 1/1/84 and after 1/1/84, as a percent of the early period mean.

Figure 1

Hosp Days and Admissions per Enrollee



the scale). The top panel shows admission rates decreasing by about 20 percent between 1983 and 1985, while days of care decreased approximately 31 percent. Obviously, length of stay decreased by the difference, about 11 percent. Admission rates declined about five percent and days of care declined seven percent between 1985 and 1986. This suggests that length of stay was approximately constant. The bottom panels of Figure 1 show that the same trends existed in MSAs and other areas; here also we see the larger drop in days of care for rural areas.

Length of Stay

Figure 2 and Tables 2 and 3 show changes in length of stay and casemix adjusted length of stay. Actual LOS decreased from 10.2 to 8.4 days (18%) over the six year period. The casemix adjusted decline in LOS is substantially larger, from 10.2 to 7.6 days (25%). As we noted earlier, some fraction of this gap is due to upcoding; some also is likely to be the result of the increased average severity of the fewer admissions. Note, however, the widespread perception that the LOS decline was beginning to diminish between 1985 and 1986 may well be an incorrect interpretation of a new stability in patient management practices. If the upcoding phenomena was stable at that point (up to two years post PPS introduction), then we would conclude that LOS was continuing to decline after allowing for the mix of patients (admission rates continued to decrease through 1986).

Table 3 and Figure 3 show trends in adjusted LOS for major hospital groups. The figures show that urban and rural hospitals trace the same path in adjusted LOS; however, urban hospitals have adjusted stay lengths that are about 18 percent higher than rural hospital stay lengths.[2] Teaching status differentials in LOS widen somewhat when adjusted for DRG mix; the only trend difference noted here is that heavy teaching hospitals do not show the same amelioration of decreases in adjusted LOS as is evident in other classes of hospitals. Differences in LOS also are compressed somewhat by the casemix adjustment. Here we see a marked increase in adjusted LOS for proprietary hospitals in 1986, but that increase (0.3 days) is less than the increase (0.6 days) we see in the unadjusted LOS (e.g. average DRG mix increased along with stay lengths).

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[2] Unadjusted, the urban hospitals have actual stay lengths that are 23% higher than rural hospital stay lengths.

Figure 2

ACTUAL AND ADJUSTED LOS

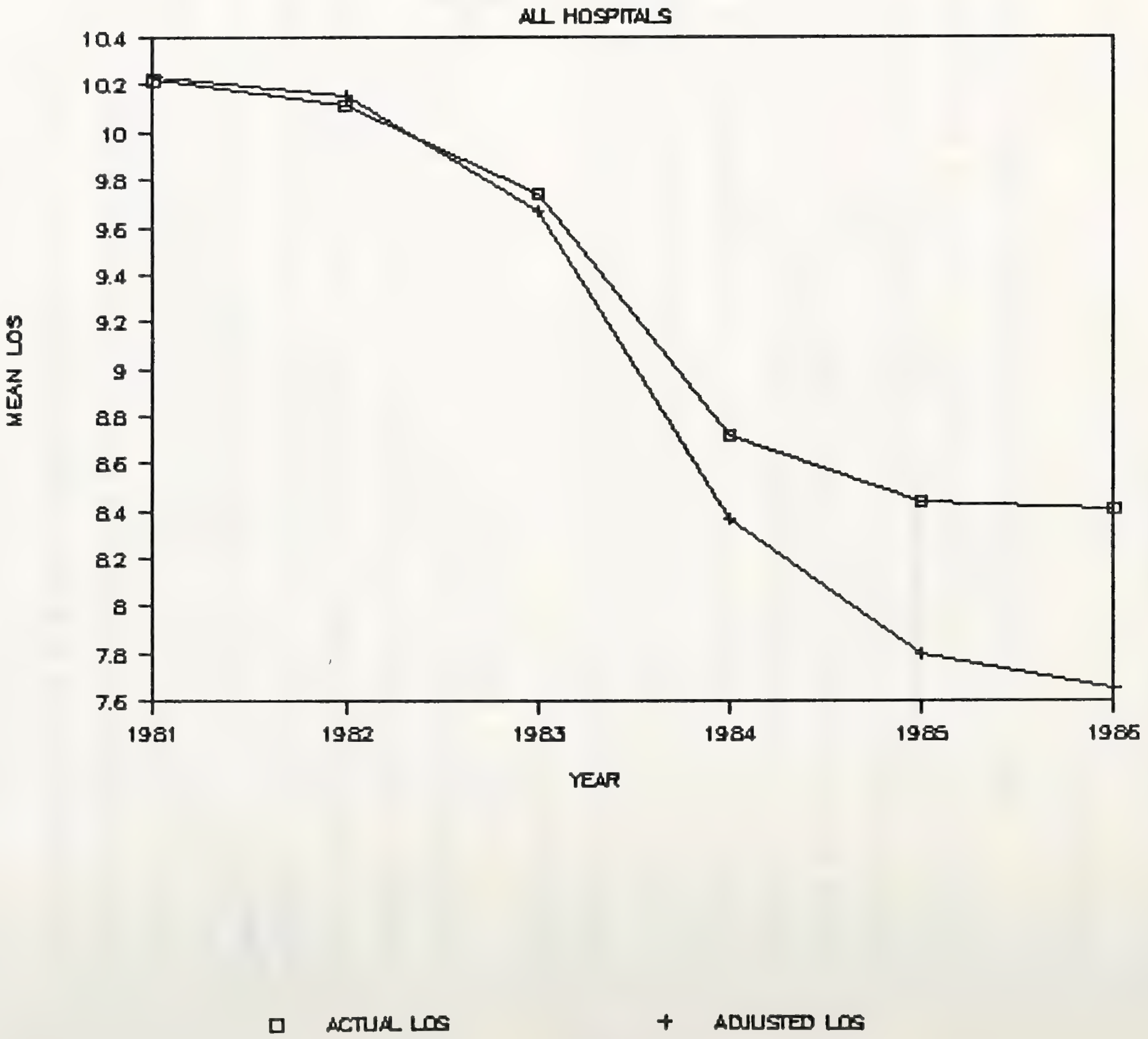


Table 2

ACTUAL LENGTH OF STAY

I. MAJOR HOSPITAL GROUPS	DISCHARGE YEAR					
	81	82	83	84	85	86
TOTAL	10.22	10.11	9.74	8.72	8.44	8.41
MED GAIN	10.31	10.17	9.81	8.82	8.53	8.48
LOW GAIN	10.60	10.58	10.05	8.73	8.35	8.39
HIGH GAIN	9.58	9.44	9.21	8.47	8.29	8.25
URBAN	10.79	10.66	10.27	9.23	8.93	8.86
RURAL	8.79	8.69	8.32	7.31	7.04	7.12
BEDS<=99	8.14	8.09	7.71	6.72	6.41	6.41
BEDS 100 TO 299	9.90	9.78	9.40	8.46	8.26	8.26
BEDS 300 TO 499	11.01	10.83	10.45	9.39	9.06	9.01
BEDS 500 TO 699	11.32	11.33	10.92	9.76	9.54	9.35
BEDS>=700	12.21	12.11	11.73	10.73	10.29	9.87
NO TEACH	9.47	9.34	8.99	8.02	7.78	7.83
LGT TEACH	11.29	11.19	10.76	9.62	9.28	9.21
HVY TEACH	12.24	12.13	11.87	10.84	10.30	9.71
NON-PROF	10.63	10.51	10.09	9.05	8.74	8.76
FOR PROF	9.15	9.06	8.82	7.89	7.67	8.25
GOV'T	9.22	9.11	8.85	7.82	7.60	7.59

TABLE 3

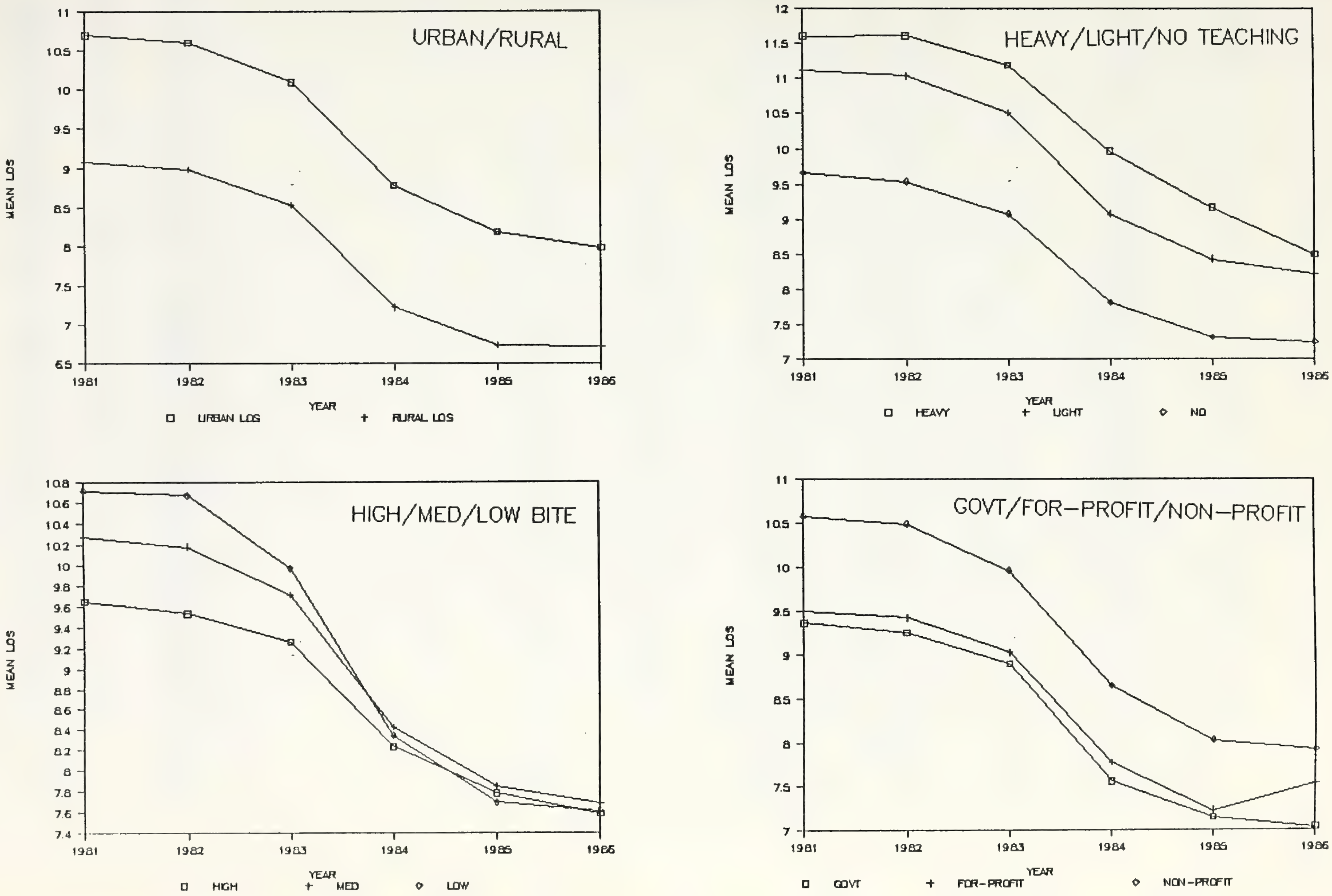
ADJUSTED LENGTH OF STAY

I. MAJOR HOSPITAL GROUPS	DISCHARGE YEAR					
	81	82	83	84	85	86
TOTAL	10.24	10.15	9.67	8.37	7.80	7.65
MED GAIN	10.27	10.18	9.71	8.43	7.85	7.69
LOW GAIN	10.72	10.67	9.97	8.35	7.70	7.62
HIGH GAIN	9.65	9.53	9.26	8.24	7.79	7.59
URBAN	10.70	10.60	10.10	8.78	8.18	7.98
RURAL	9.08	8.98	8.53	7.23	6.74	6.72
BEDS>=99	8.53	8.46	8.01	6.74	6.24	6.17
BEDS 100 TO 299	10.05	9.95	9.48	8.24	7.71	7.59
BEDS 300 TO 499	10.87	10.72	10.21	8.87	8.24	8.08
BEDS 500 TO 699	11.03	11.11	10.56	9.12	8.58	8.24
BEDS>=700	11.74	11.70	11.16	9.89	9.21	8.69
NO TEACH	9.66	9.54	9.08	7.82	7.32	7.25
LGT TEACH	11.11	11.04	10.51	9.08	8.43	8.23
HVY TEACH	11.60	11.61	11.19	9.96	9.17	8.50
NON-PROF	10.58	10.49	9.96	8.64	8.03	7.92
FOR PROF	9.50	9.42	9.02	7.77	7.23	7.53
GOV'T	9.36	9.25	8.89	7.56	7.15	7.04

Figure 3

ADJUSTED LOS

ALL HOSPITALS



The most interesting pattern relates to the classes of hospitals defined by the "bite" or PPS gain variable.[3] Projected relative losers under PPS (low "bite" or gain) had the longest LOS (the differential is not affected by the casemix adjustment) and the largest drop in LOS over the period, as would be predicted and found by Feder, et al, (1987)[4] and Merrell (1988)[5]. The adjusted data show a much smaller end point gap in LOS for these hospitals than is evident in the unadjusted data.

State Tables

Tables 4 (Actual LOS) and 5 (Adjusted LOS) show average LOS by state over the 1981-86 period. There is not much learned regionally by adjusting for casemix, as shown in Table 6. The rankings of states hardly is affected by the adjustment. However, there is some evidence of compression across the states through the casemix adjustment. Using New York and Idaho data, we see that a slight compression occurs in the extremes. It still is alarming that LOS, even after adjustment for patient mix, remains about twice as high in northeastern industrial states as compared to the northwest areas of the country.

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[3] Defined by top (high), bottom (low), and middle quartiles of the measure of expected percent change in total hospital revenue due to a fully phased in PPS as based on the TEFRA cost report. High indicates the most favorable impact.

[4] Feder, et al, "How Did Medicare's Prospective Payment System Affect Hospitals?" New England Journal of Medicine, Vol. 317, No. 14, 1 Oct. 87, pp. 867-73.

[5] Merrell, Katie, Isolating the Effect of PPS on Hospital Behavior: Another Look at the PPS Impact Index and Its Use, HCFA Working Paper, August 24, 1988.

Table 4

ACTUAL LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
ALABAMA	9.15	8.96	8 .56	7.97	7.78	7.90
ALASKA	8.03	8.53	8.08	7.76	7.51	7.89
ARIZONA	8.94	8.99	8.55	7.74	7.32	7.24
ARKANSAS	8.22	8.05	7.86	7.01	6.93	7.56
CALIFORNIA	8.69	8.62	8.32	7.39	7.24	7.25
COLORADO	9.23	9.09	8.55	7.25	6.96	7.13
CONNECTICUT	11.09	11.17	10.64	9.75	9.36	9.40
DELAWARE	11.50	11.27	11.35	9.87	8.97	8.80
DISTRICT OF COLUMBIA	13.63	14.19	13.36	11.64	11.57	9.02
FLORIDA	9.61	9.53	9.20	8.21	8.02	8.19
GEORGIA	8.41	8.24	8.12	7.42	7.44	7.54
HAWAII	9.58	9.70	9.51	8.98	8.37	8.57
IDAHO	7.36	7.13	6.88	6.12	6.06	6.11
ILLINOIS	11.43	11.24	10.59	9.21	8.79	8.98
INDIANA	10.62	10.53	10.02	8.50	8.21	8.20
IOWA	9.17	9.09	8.53	7.65	7.16	7.37
KANSAS	9.40	9.33	8.85	7.55	7.15	7.15
KENTUCKY	9.24	9.18	9.05	8.19	7.81	7.84
LOUISIANA	8.95	8.89	8.68	7.60	7.47	7.41
MAINE	9.61	9.26	8.88	8.37	8.71	9.06
MARYLAND	12.31	11.78	11.22	10.11	9.69	9.64

(CONTINUED)

Table 4

ACTUAL LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
MASSACHUSETTS	12.71	12.43	11.98	11.46	10.98	10.33
MICHIGAN	10.83	10.65	10.30	8.88	8.44	8.49
MINNESOTA	9.49	9.32	8.81	7.22	6.90	6.81
MISSISSIPPI	9.13	9.01	8.76	7.49	7.32	7.51
MISSOURI	10.53	10.33	9.82	8.46	8.22	8.41
MONTANA	7.83	7.58	7.48	6.82	6.14	6.31
NEBRASKA	9.04	8.83	8.59	7.56	7.30	7.36
NEVEDA	8.80	8.36	8.05	7.71	7.42	7.37
NEW HAMPSHIRE	9.67	9.49	9.11	8.38	8.06	8.32
NEW JERSEY	12.46	12.37	12.30	11.86	11.57	11.54
NEW MEXICO	8.35	8.12	7.93	6.84	6.62	6.68
NEW YORK	14.09	14.21	14.01	13.74	13.04	11.75
NORTH CAROLINA	10.09	10.17	9.76	8.54	8.67	8.87
NORTH DAKOTA	8.70	8.77	8.66	7.47	7.06	7.33
OHIO	11.28	11.05	10.45	8.77	8.26	8.40
OKLAHOMA	8.55	8.49	8.49	7.43	7.39	7.49
OREGON	7.93	7.74	7.25	6.20	5.98	6.15
PENNSYLVANIA	11.62	11.43	10.89	9.43	8.84	8.84
PUERTO RICO	.	9.26	9.01	8.66	8.16	7.87
RHODE ISLAND	12.49	12.25	10.74	10.42	10.07	10.48
SOUTH CAROLINA	10.11	9.72	9.41	8.64	8.60	8.43

(CONTINUED)

Table 4

ACTUAL LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
SOUTH DAKOTA	8.63	8.54	7.94	6.89	6.67	6.72
TENNESSEE	9.66	9.57	9.34	8.31	8.27	8.16
TEXAS	8.99	9.13	8.82	7.85	7.57	7.76
UTAH	7.50	7.59	7.44	6.16	6.23	6.23
VERMONT	10.52	10.35	9.99	8.68	8.73	9.02
VIRGINIA	10.81	10.67	10.13	8.98	8.85	8.98
WASHINGTON	7.66	7.57	7.34	6.43	6.27	6.34
WEST VIRGINIA	9.76	9.52	9.10	7.92	7.64	8.02
WISCONSIN	10.28	9.88	9.24	8.09	7.66	7.71
WYOMING	7.84	8.04	7.96	7.33	6.47	6.51

TABLE 5

ADJUSTED LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
ALABAMA	9.53	9.45	8.82	7.80	7.35	7.35
ALASAKA	7.91	8.65	8.21	7.45	6.85	7.04
ARIZONA	8.71	8.78	8.37	7.18	6.53	6.52
ARKANSAS	8.42	8.29	8.10	6.96	6.66	7.10
CALIFORNIA	8.56	8.52	8.11	6.93	6.49	6.47
COLORADO	9.33	9.13	8.47	6.93	6.23	6.19
CONNECTICUT	10.74	10.98	10.21	8.97	8.50	8.21
DELWARE	11.35	11.15	11.12	9.45	8.31	8.18
DISTRICT OF COLUMBIA	13.31	13.84	12.88	10.92	10.35	8.19
FLORIDA	9.79	9.59	9.17	7.84	7.41	7.44
GEORGIA	8.50	8.44	8.23	7.24	6.99	7.02
HAWAII	9.14	9.23	8.98	8.20	7.30	7.50
IDAHO	7.38	7.27	6.97	5.88	5.60	5.60
ILLINOIS	11.26	11.03	10.46	8.89	8.24	8.19
INDIANA	10.53	10.60	10.16	8.15	7.51	7.44
IOWA	9.23	9.20	8.43	7.10	6.47	6.63
KANSAS	9.62	9.64	8.95	7.24	6.63	6.53
KENTUCKY	9.30	9.36	9.20	7.92	7.43	7.35
LOUISIANA	9.17	9.06	8.85	7.53	7.12	6.92
MAINE	9.46	9.04	8.84	7.98	7.95	8.29
MARYLAND	11.96	11.50	11.06	9.80	8.90	8.68

(CONTINUED)

TABLE 5

ADJUSTED LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
MASSACHUSETTS	12.41	12.40	11.79	11.08	10.01	9.28
MICHIGAN	10.75	10.49	10.23	8.57	7.81	7.74
MINNESOTA	9.41	9.17	8.50	6.58	6.09	5.94
MISSISSIPPI	9.48	9.39	9.21	7.54	7.16	7.31
MISSOURI	11.08	11.43	9.84	8.06	7.56	7.57
MONTANA	7.87	7.51	7.38	6.45	5.78	5.79
NEBRASKA	9.06	8.84	8.53	7.31	6.74	6.60
NEVADA	8.73	8.67	7.85	7.12	6.58	6.42
NEW HAMPSHIRE	9.79	9.63	9.07	7.98	7.46	7.49
NEW JERSEY	12.28	12.11	11.93	11.33	10.71	10.48
NEW MEXICO	8.45	8.21	7.85	6.51	6.17	6.13
NEW YORK	13.94	13.89	13.82	13.40	12.36	10.80
NORTH CAROLINA	10.16	10.25	9.68	8.08	7.84	7.91
NORTH DAKOTA	8.69	8.91	8.77	7.33	6.44	6.67
OHIO	11.15	10.92	10.33	8.37	7.64	7.69
OKLAHOMA	8.82	8.72	8.56	7.17	6.79	6.82
OREGON	7.70	7.50	7.11	5.80	5.40	5.44
PENNSYLVANIA	11.28	11.27	10.69	9.00	8.13	8.07
PUERTO RICO	.	9.60	9.23	8.76	8.21	7.84
RHODE ISLAND	12.07	11.84	10.34	9.72	9.11	9.48
SOUTH CAROLINA	10.78	9.91	9.44	8.31	8.09	7.84

(CONTINUED)

TABLE 5

ADJUSTED LENGTH OF STAY

50 STATES	DISCHARGE YEAR					
	81	82	83	84	85	86
SOUTH DAKOTA	8.76	8.88	8.17	6.77	6.28	6.22
TENNESSEE	9.96	9.89	9.49	8.22	7.78	7.58
TEXAS	9.50	9.46	8.84	7.57	6.96	6.97
UTAH	7.56	7.76	6.94	5.59	5.50	5.45
VERMONT	10.68	10.67	9.98	8.27	8.14	8.17
VIRGINIA	10.82	10.71	10.07	8.62	8.30	8.26
WASHINGTON	7.47	7.36	7.03	5.88	5.57	5.58
WEST VIRGINIA	9.93	9.77	9.21	7.77	7.28	7.52
WISCONSIN	10.24	9.92	9.18	7.56	6.83	6.82
WYOMING	8.14	8.48	8.20	7.12	6.15	6.07

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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--
EPISODES OF HOSPITALIZATION AND PPS

Working Paper

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Episodes of Hospitalization and PPS

Abstract

This paper describes service use by Medicare beneficiaries for the periods before, during and following their hospital stay. Ten types of admissions and about 120,000 cases over the 1981-1986 period are studied to isolate changes in service use patterns. Medicare claim and bill data for all Part A and Part B providers are used to measure episode use patterns and reimbursements. Only descriptive methods are used to examine the data, complemented by simple statistical tests of mean differences between the 1981-83 and 1984-86 periods.

In general and in the broadest terms, we can say that between 1981 and 1986 the practice trends for these tracers have been:

- marked cuts in LOS, about 25% of which is due to pre-surgery day reductions for surgical tracers;
- no evidence of potentially untoward incentives to reduce intensity; access to ICCU or other ancillary services has not been reduced;
- substantially less indication of changes in service use in the pre admission period relative to the immediate post period;
- large and pervasive increases in the likelihood of getting SNF, DME, and HHA services; for the latter, the increase in HHA admission rates almost is solely due to higher admission rates in the week following discharge--providing strong evidence of substitution against LOS reductions;
- fewer patients are being transferred; coupled with lower LOS; this may be related to higher readmission rates;[1] PPS may be encouraging hospitals and physicians to take more readmission risks;
- physicians are providing fewer services in the hospital, and more in the office;
- practice pattern changes have not altered the fundamental structure of reimbursement; episode reimbursements are still dominated by payments made while an inpatient, and costs to Medicare are increasing by about the same rate as the DRI Medical care price index. The fraction of episode payments for care delivered within 30 days of discharge is higher; ranges from

---

[1] There is no evidence that mortality has changed.

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5-17% of total episode payments, about half of which is for rehospitalization.

The paper is organized into sections Background and Issues (1.0), Methods (2.0), Stroke Episodes (3.0), Hip Surgery Episodes (4.0), Pneumonia Episodes (5.0), Inguinal Hernia Surgery Episodes (6.0), and a Summary (7.0). An appendix contains a methods paper on selecting tracers and a theory paper on physician use of hospital resources.

1.0 BACKGROUND AND ISSUES

A number of powerful forces have been at work during the 1980s, influencing physician/patient decisionmaking regarding the way hospitals and other services are used to deal with episodes of illness for Medicare beneficiaries. Among the most powerful influences are:

- -- Introduction of PROs: providing regulatory oversight on admission, transfer, and readmission decisions for Medicare and Medicaid beneficiaries, and monitoring quality of care rendered (late 1983 start).
- -- Introduction of PPS: altering payment for Medicare hospitalizations from cost basis to fixed price basis per DRG (late 1983 start). Similar programs have been replacing cost based payment for Medicaid programs and other payors since before 1980.
- -- Changes in Diagnostic and Treatment Technology: microsurgery and laser surgery techniques have been developed and increasing reliance on day-surgery for simpler, routine procedures. Drug and other non-surgical technologies have also replaced surgery as the most common and preferred treatment for some diseases.
- -- Private Sector Payment Safeguard Programs: employers, insurors and Blue Cross plans have implemented, on a wide scale, various pre-authorization and utilization review programs to limit inpatient payments and surgical fees. While not Medicare, such programs treat the same set of physician and hospital providers.
- -- Growth in Capitated or Competitive Plans: Medicare along with most employers are offering options for enrolling in capitated plans or preferred provider and managed care options to the traditional insurance program. This groundswell of activity should threaten income for providers (hospitals and physicians).
- -- Extended HHA Benefits: In 1981 the Medicare home care (HHA) benefit was liberalized, including elimination of the requirement of a prior 3-day stay to be eligible for HHA benefits. This change sparked rapid growth in supply and service use (Williams et al., 1984).
- -- Medicare Hospice Benefit Implementation: In 1983 Medicare adopted an incentive reimbursement approach for terminally ill persons, which required delivery of previously non-covered services and discourages use of expensive inpatient services in favor of palliative care at home.

Along with ever increasing supplies of physicians, these new competitive pressures, and reduced occupancy rates in hospitals (due to factors noted above) have generated significant revenue threats on physicians and hospitals, putting pressure on established methods of generating revenue from patient care. External pressures on both

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providers also have tended to impose limits on practice patterns--particularly in terms of how intensely the hospital is used (or is not used) in the care of particular patients. Who should be admitted, how long they stay, where testing is done, what followup care is necessary are not different questions; but established professional practices on these issues have certainly been exposed to new constraints.

We cannot hope to distinguish, in a causal way, the source of any change--due to the systemic pattern of market events that are acting to exert pressure on the decisions physician and patients must make about patterns of care. But, there are a number of general hypotheses about PPS influences that can be developed from a model (Appendix A) of episode care wherein physicians are subjected to elevated "hassle factors or pressures" associated with using hospital services under PPS.

This model would predict four types of utilization changes or substitutions due to pressures that discouraged hospital use. Substitution would occur between high (intense) and low cost services in hospitals (e.g., between ICU/CCU and routine care) and general intensity of ancillary use would fall for a given length of stay. We would also expect a substitution of certain outpatient care for inpatient services including testing, pre-operative care, and ambulatory surgery. There also should be substitution across hospitals to accommodate specialization and transfer strategies pursued by hospitals (e.g., differential service "prices" across hospitals faced by physicians). Finally, we can expect substitution of formal and informal aftercare services for routine hospital services. The intensity of these effects will depend on the nature of the illness spell (e.g., the flexibility of the technology for producing health); the "bite" of PPS on hospitals, which indexes the vigor with which hospitals pursue utilization control policy; and the market structures for hospitals, physicians and other providers which set practical boundaries on the behaviors of hospitals and physicians.

The issue addressed in this paper is whether and how PPS and the other influences on utilization of covered Medicare services have altered the pattern of practice for episodes of care involving hospitalization in the 1980s. To a lesser extent, we also are concerned with the variances in practice pattern trends in different locations (urban and rural) and in hospitals with different organizational missions. We are unable to examine substitution against hospital admission, since there have been no Part B data capturing diagnosis; possibly the BMAD data will permit this type of episode-initialization in subsequent studies of this type.

2.0 METHODS

2.1 Selecting Tracers

The selection of cases to study was arbitrary--though we were concerned with several general problems:

- frequency in the Medicare population
- representation of both surgical and medical admissions
- absence of important new treatment modalities during the study period

Using these general guidelines we selected inguinal hernia repair, stroke, hip surgery and pneumonia.

We were concerned that coding changes would artificially change case selection over time. In an effort to minimize this problem we sampled on fairly broad groups of ICD9 diagnosis and procedure codes, hoping that any "creep" in coding would occur within the set of selected codes. The broad groups included were:

1. Inguinal Hernia Repair; procedure codes 530X and 531X.
2. Stroke; diagnostic codes 431, 431.0, 431.00, 433XX, 436, 436.0 and 436.00.
3. Hip Surgery; procedure codes 815, 815.0, 815.1, 815.2, 816, 816.0, 816.1, 816.2, 816.3, 816.4, and 816.9.
4. Pneumonia; diagnostic codes 481, 481.0, 481.00, 482XX, 483, 483.0, 483.00, 485, 485.0, 485.00, 486, 486.0, and 486.00.

The resulting distribution of DRGs, diagnosis and procedure codes we captured in our broad sampling procedure are shown in Tables 1a-1d.

We selected a number of tracer categories from within the four broad groups. This was done because of the substantial clinical differences in cases within the broad groups (e.g., TIAs and stroke) and because of the wide disparities we see in cases using the group selection rules reflected on Tables 1a-1d.

For the pneumonia group, we use two groups of cases: those bacterial pneumonias classified as either DRG 79 or 80, and those simple pneumonias classified as either DRG 89 or 90. DRG 91 and others are not used, nor is any diagnostic distinction made beyond that used to differentiate between 79/80 and 89/90. These complicated/uncomplicated pairs are pooled because of the obvious 'creep' that seems to occur over the

Table 1(a)

DRG BY ICD-9-CM CODE GROUP: HIP REPLACEMENT

DRG	OSTEO-ARTHROSIS	RHEUMATOID	OSTEO-PATH	FRACTURES	COMPLICATIONS
209	26.94	3.32	0.25	43.65	5.15
210	0.53	0.17	0.01	5.33	0.18
211	0.17	0.14	0.02	0.44	0.07
471	0.02	0.01	0.00	0.03	0.02
OTHER	0.94	0.19	0.01	0.95	2.61

ICD-9-CM Code

Osteoarthrosis	71500, 71509, 71510, 71515, 71520, 71525, 71530, 71535, 71536, 71589, 71590, 71595, 71596, 71598
Rheumatoid	7140, 71610, 71615, 71660, 71690, 71695, 71696, 71815, 71835, 71850, 71855, 71865, 71885, 71890, 71895, 71900, 71940, 71945, 71946, 71985, 71990, 71995, 71999, 7200, 7213, 72190
Osteopath	73005, 73015, 73025, 73028, 7310, 7321, 7327
Fractures	8028, 80500, 8052, 8080, 80843, 8088, 8090, 81201, 81203, 81249, 81341, 81220, 81240, 81342, 82000, 82002, 82003, 82009, 82012, 82019, 82020, 82021, 82022, 82031, 8208, 8209, 82100, 82101, 82120, 82122, 8270, 8290
Complicated	9964, 9965, 9966, 9967, 9985

Table 1(b)

DRG BY ICD-9-CM CODE GROUP: HERNIA

DRG	BILATERAL	UNILATERAL	COMPLICATIONS	NEOPLASMS & CIRC.	OTHER ABDOMINAL	OTHER
161	7.34	46.62	7.15	0.09	0.94	0.60
162	3.03	18.66	1.12	0.02	0.31	0.15
188	0.05	0.26	0.02	0.00	0.01	0.00
189	0.02	0.14	0.01	0.00	0.00	0.00
OTHER	0.13	3.28	1.06	2.41	0.63	5.81

ICD-9-CM Code

Bilateral	55092, 55093
Unilateral	55090, 55091
Complicated	55000, 55001, 55002, 55003, 55010, 55011, 55012, 55013
Neoplasms & Circ.	1500-2390, 3900-4599
Other Abdominal	55100-5539

Table 1(c)

DRG BY ICD-9-CM CODE GROUP: PNEUMONIA

DRG	PNEUMOCOCCAL	BACTERIAL	ORG. NEC	BRONCHO	ORG. NOS
079	0.00	5.04	0.00	0.00	0.00
080	0.00	0.26	0.00	0.00	0.00
089	6.35	6.69	0.76	8.81	59.55
090	0.81	0.56	0.15	1.10	7.85
091	0.00	0.00	0.00	0.00	0.01
OTHER	0.11	0.40	0.02	0.14	1.25

	ICD-9-CM CODE
Pneumoccal	481
Bacterial	4820, 4821, 4822, 4823, 4824, 4828, 4829
Pneumonia Org., NEC	483
Broncho	485
Pneumonia Org., NOS	486

Table 1(d)

DRG BY ICD-9-CM CODE GROUP: STROKE

DRG	HEMMORRHAGE	PRECEREBRAL OCCLUSIONS	CEREB. ART. OCCLUSIONS	CVA
001	0.49	0.06	0.05	0.10
005	0.00	10.05	0.16	0.23
007	0.01	0.06	0.08	0.10
014	4.90	0.00	26.69	48.39
015	0.00	6.15	0.00	0.00
OTHER	0.06	0.57	0.84	0.94

	ICD-9-CM CODE
Hemmorrhage	431
Precerebral Occlusion	4330, 4331, 4332, 4333, 4338, 4339
Cerebral Artery Occlusion	4340, 4341, 4349
CVA	436

six years of data. This is evident on Table 2 below for both pneumonia and hernia cases, where we also pool across DRGs.

For stroke, we separate cases into three DRG groups: TIAs (015), Stroke (014), and Surgery (005). No further refinements are made. For hip surgery, we use only cases classified into DRG 209 (Major Joint and Limb Reattachments). Within that DRG we look separately at diagnoses of osteoarthrosis and fractures, ignoring other cases in the DRG. For inguinal hernia, we look only with the complicated/uncomplicated pair of DRGs 161/162. Pairing was done because of evidence of DRG creep. Three subgroups are defined based on diagnosis: bilateral, unilateral and inguinal hernias with complications (usually obstructions or gangrene). Here we ignore cases not grouped into DRG 161/162 and all diagnoses of neoplasms and other abdominal hernias. A more detailed description of the selected subtracers is found in Exhibit 1.

2.2 Admission Patterns

Tables 2 and Figures 1 and 2 show admission rates for the ten tracer categories. Admission rates for pneumonia, stroke and hip tracers are generally increasing over the study period; the most rapid increases are for DRG 79/80, DRG 005 and both hip groups. Hernia admission rates for the programs are fairly flat overall, but somewhat higher for the complicated group. Figure 2 indicates that urban beneficiaries (SMSA residence) have higher admission rates for hips, stroke and hernias and lower admit rates for pneumonia. Beneficiaries in PPS states (non-waiver) have higher admit rates for all groups except hernias. Trends suggest that admission rates are moving in a nearly identical pattern for urban and rural beneficiaries and for persons in waiver and non-waiver states.

2.3 Defining Episodes

Episodes are generally defined to be the period preceding, during and following the acute inpatient stay. As such, each episode is initialized by the hospital admission, rather than the onset of illness. Even though Part B data were used here, the available HCFA data (payment records) did not include diagnostic or procedure codes, which might allow episodes of illness to be initialized by first mention of a particular medical problem.

Consequently, what we study here is the services consumed during the window of time surrounding the study. We capture measures for the periods:

Table 2

DISCHARGE RATES PER 1000 ENROLLEES BY TRACER AND SUBTRACERS

		1981	1982	1983	1984	1985	1986	1986 DRG WEIGHT	
	TOTAL	9.71	9.55	11.14	12.16	13.16	13.92		
PNEUM	DRG 79,80	0.12	0.12	0.23	0.71	0.91	1.03	1.9546	1.4403
	% DRG79	0.83	0.86	0.90	0.97	0.98	0.97		
	DRG 89,90	7.93	7.76	8.92	9.14	9.92	10.27	1.1768	0.8900
	% DRG89	0.84	0.84	0.82	0.93	0.95	0.96		
	TOTAL	10.79	11.55	12.64	13.69	13.00	12.78		
STROKE	DRG 015	0.48	0.62	0.64	0.78	0.74	0.67	0.6241	
	DRG 005	0.56	0.55	1.04	1.38	1.41	1.29	1.6510	
	DRG 014	7.53	7.74	8.19	8.86	8.70	8.76	1.3144	
	TOTAL	2.83	2.95	3.68	4.05	4.10	4.23		
HIP (209)	OSTEO	0.67	0.65	0.90	1.09	1.17	1.22	2.3930	
	FRACT	0.84	0.93	1.31	1.75	1.85	2.04	2.3930	
	TOTAL	3.29	3.37	3.97	4.25	3.61	3.33		
HERNIA (161,162)	COMPLIC	0.18	0.12	0.23	0.35	0.39	0.32	0.6538	0.5264
	BILAT	0.30	0.42	0.37	0.43	0.36	0.35	0.6538	0.5264
	UNILAT	2.22	2.06	2.48	2.74	2.19	1.96	0.6538	0.5264
	% DRG161	0.71	0.71	0.67	0.74	0.77	0.78		

Exhibit 1

DESCRIPTION OF SUBTRACERS

Pneumonia

1. DRG 79 Respiratory Infections and Inflammations Age > 17 with CC
   80 Respiratory Infections and Inflammations Age > 17 without CC
   Includes: TB

2. DRG 89 Simple Pneumonia and Pleurisy Age > 17 with CC
   90 Simple Pneumonia and Pleurisy Age > 17 without CC
   Includes: penumococcal, streptococcal and bacterial pneumonia

Stroke

1. DRG 015 Transient Ischemic Attack and Precerebral Occlusions
2. DRG 005 Extracranial Vascular Procedures
   Includes: endarterectomy, suture of arteries, veins and vessels
3. DRG 014 Specific Cerebrovascular Disorders Except TIA
   Includes: hemorrhage, cerebral thrombosis and embolism, Cva

Hip Replacement

DRG 209 Major Joint and Limb Reattachment Procedures

1. Osteoarthrosis + DRG 209
2. Fractures + DRG 209

Hernia

DRG 161 Inguinal and Femoral Hernia Procedures Age > 17 with CC
DRG 162 Inguinal and Femoral Hernia Procedures Age > 17 without CC

1. Bilateral + DRG 161, 162
   Includes: Bilateral inguinal hernia, recurring
   Bilateral inguinal hernia

2. Unilateral + DRG 161, 162
   Includes: Unilateral inguinal hernia, recurring
   Unilateral inguinal hernia

3. Complicated + DRG 161, 162
   Includes: Bilateral or unilateral inguinal hernia with an obstruction or gangrene

Figure 1

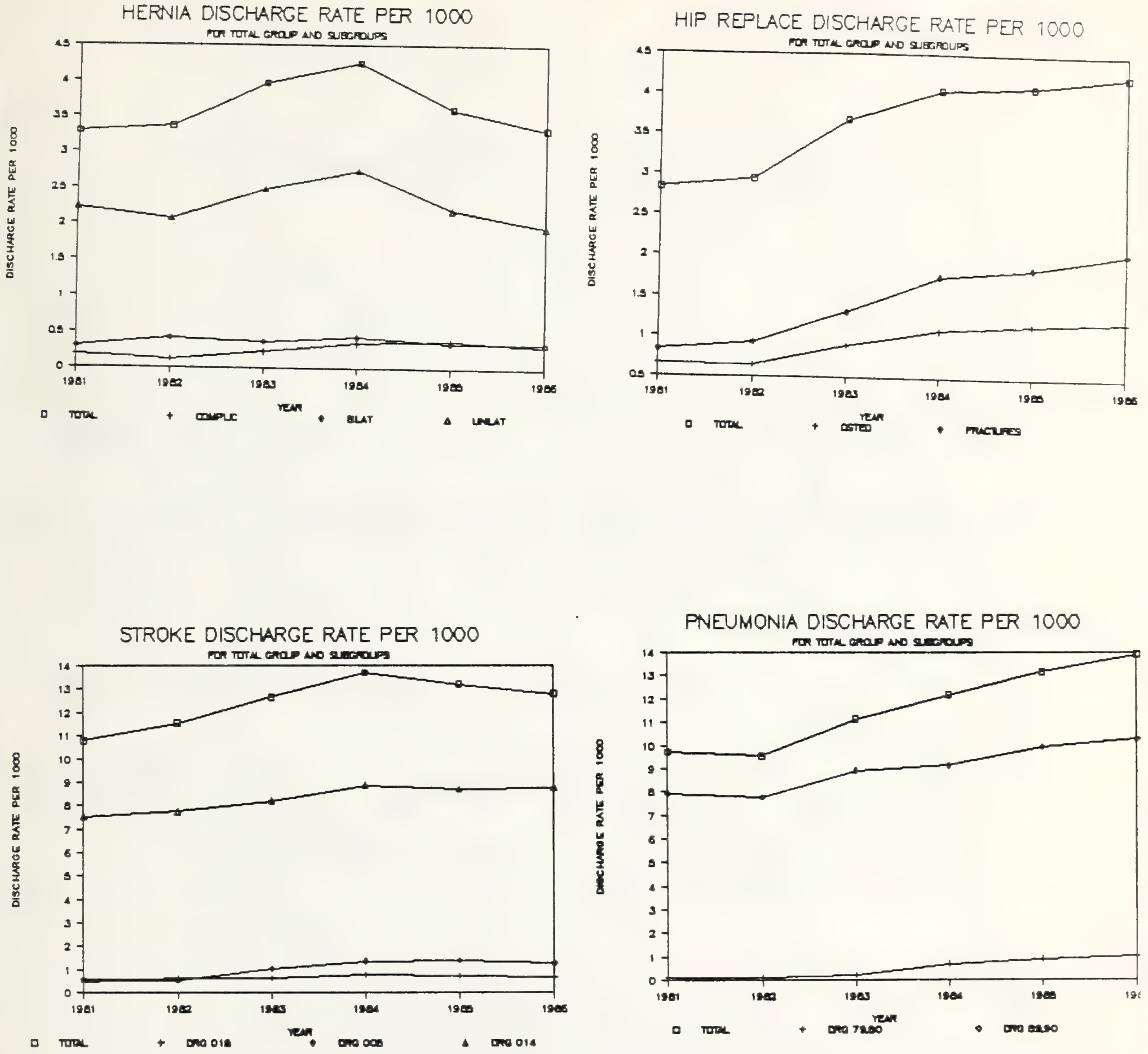
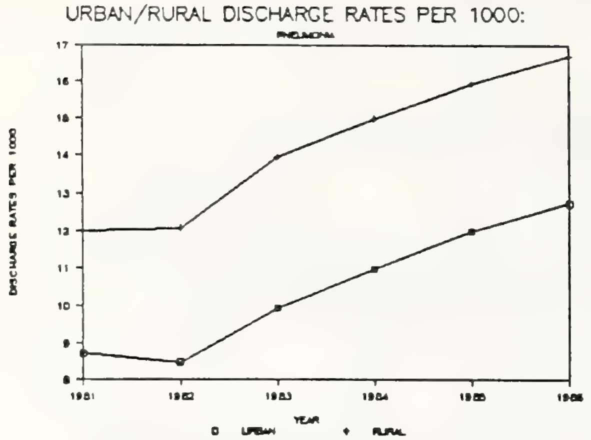
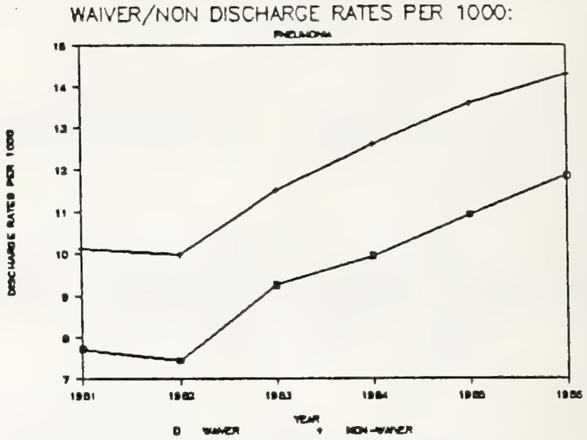

HERNIA DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
1981
1982
1983
1984
1985
1986
YEAR
□ TOTAL
+ COMPLIC
◆ BILAT
△ UNILAT
HIP REPLACE DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
0.5
1
1.5
2
2.5
3
3.5
4
4.5
1981
1982
1983
1984
1985
1986
YEAR
□ TOTAL
+ OSTEO
◆ FRACTURES
STROKE DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1981
1982
1983
1984
1985
1986
YEAR
□ TOTAL
+ DRG 016
◆ DRG 005
▲ DRG 014
PNEUMONIA DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1981
1982
1983
1984
1985
YEAR
□ TOTAL
+ DRG 79,80
◇ DRG 89,90

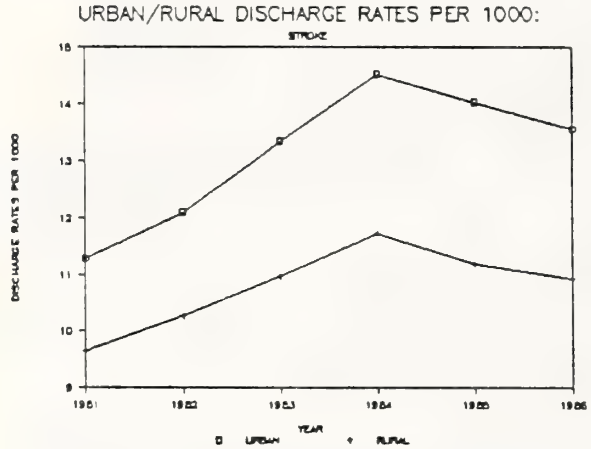
Figure 2



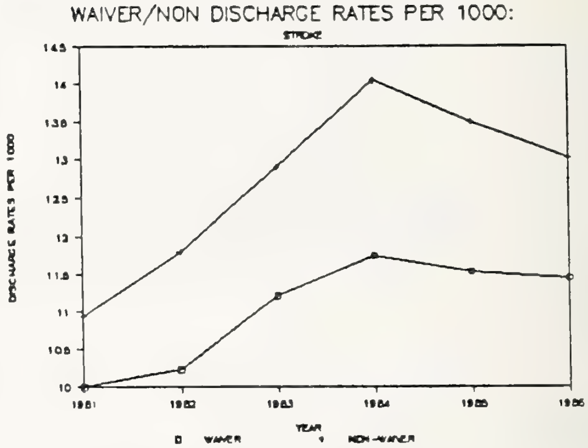
URBAN/RURAL DISCHARGE RATES PER 1000:
PNEUMONIA
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ URBAN
+ RURAL



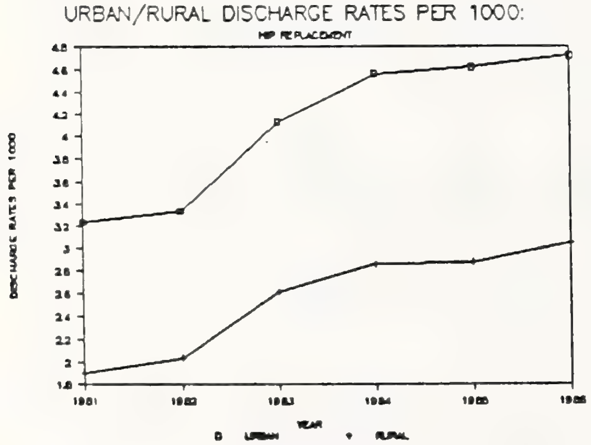
WAIVER/NON DISCHARGE RATES PER 1000:
PNEUMONIA
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ WAIVER
+ NON-WAIVER



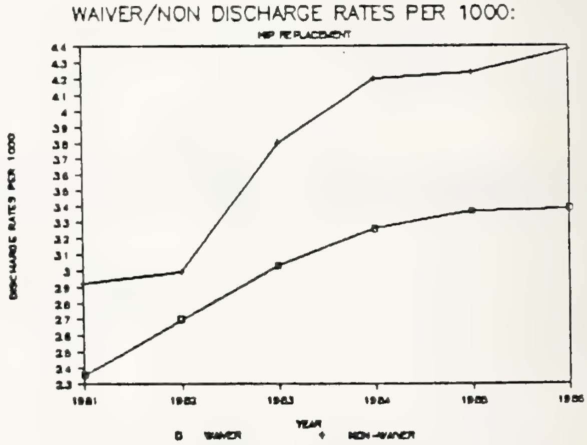
URBAN/RURAL DISCHARGE RATES PER 1000:
STROKE
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ URBAN
+ RURAL



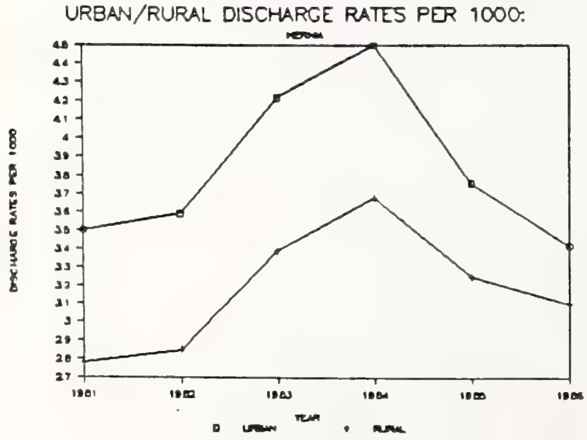
WAIVER/NON DISCHARGE RATES PER 1000:
STROKE
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ WAIVER
+ NON-WAIVER



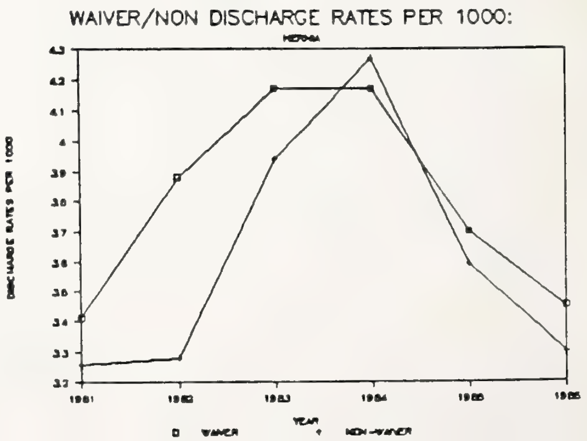
URBAN/RURAL DISCHARGE RATES PER 1000:
HIP REPLACEMENT
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ URBAN
+ RURAL



WAIVER/NON DISCHARGE RATES PER 1000:
HIP REPLACEMENT
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ WAIVER
+ NON-WAIVER



URBAN/RURAL DISCHARGE RATES PER 1000:
HERNIA
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ URBAN
+ RURAL



WAIVER/NON DISCHARGE RATES PER 1000:
HERNIA
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ WAIVER
+ NON-WAIVER

- 31-60 days before admission
- 30 days before admission
- during the stay (or transfer stay)
- 7 days after discharge
- 8-14 days after discharge
- 15-30 days after discharge
- 31-60 days after discharge

Most measures we make over the "episode" are defined for the period spanning 30 days before to 30 days after the stay.

To make these cases more homogeneous we eliminate cases where hospital care was used in the 30-day pre-period. While this may eliminate some of the more severe, complicated cases, it also will eliminate cases where the sampled stay is a transfer, readmission or rehospitalization.

2.4 Measures that Characterize the Episode

A large number of measures are used to characterize the episode of hospitalization for each of the tracers. We group measures into seven groups. The measures and groups are as follows:

- Features of Admitted Cases

    -- average beneficiary age
    -- sex; percent female
    -- race; percent nonwhite
    -- eligibility; percent aged
    -- percent with SNF stays in the 30 days prior to admission
    -- percent with HHA visits in the 30 days prior to admission
    -- percent with hospital stays in the 31-60 day period prior to admission
    -- total physician ambulatory payments[1] in pre-60-day period
    -- total Medicare reimbursement payments in pre-60-day period.

- Use of Hospital Services

    -- average length of stay
    -- transfer rate to other hospitals

---

[1] All dollar amounts are Medicare reimbursements (not charges) and all are deflated using the published DRI National Medicare Price Index, using 1981 dollars. The inflation rates for 1981-86 are, 1.0, 1.12, 1.22, 1.29, 1.37, and 1.51.

- transfer to unit within same hospital (not available before 1984)
- percent of persons using ICU or CCU services
- ratio of ancillary to total charges
- average number of pre-surgery days (for surgery tracers)
- percent with rehospitalizations (to another hospital) within 7 days post discharge
- percent readmitted (to same hospital) within 7 days post discharge.

- Part B Service Use

  - physician reimbursements for services rendered in the inpatient setting, pre-30 to post-30 days of the sample stay
  - physician reimbursements for services rendered in the office or ambulatory setting, pre-30 to post-30 days of the sample stay
  - ratio of all physician reimbursement (inpatient plus office) to hospital reimbursement
  - percent with DME reimbursements, pre-30 to post-30 days of the stay
  - average number of OPD clinic visits, pre-30 to post-30 days of the stay
  - average number of ER clinic visits, pre-30 to post-30 days of the stay
  - percent of persons with OPD bills with surgery, pre-30 to post 30 days of the stay.

- Post Hospital SNF And HHA Services

  - percent with covered SNF admits in post 7-day period
  - percent with covered SNF admits in post 30-day period
  - average number of SNF days in post 30-day period
  - percent with covered HHA visits in post 7-day period
  - percent with covered HHA visits in post 14-day period
  - percent with covered HHA visits in post 30-day period
  - percent with covered HHA visits in post 60-day period
  - average number of HHA visits in post 7-day period
  - average number of HHA visits in post 14-day period
  - ratio of HHA skilled nursing visits to total HHA visits in post 30-day period
  - average number of HHA therapy visits in post 14-day period
  - post hospital care rate in post 7-day period.

- Medicare Expenditures for the Episode

  - total episode Medicare reimbursement (pre 30 days to post 30 days)
  - percent of episode reimbursement prior to admission
  - percent of episode reimbursement after discharge
  - percent of episode reimbursement during the stay (includes all Part A and Part B inpatient reimbursements)
  - percent of episode reimbursement paid to physicians
  - percent of episode reimbursement for Part B
  - percent of episode reimbursement for HHA services
  - percent of episode reimbursement for SNF services
  - total hospital payment for the sampled stay

- Geographic Use Patterns

  - percent of stays where beneficiary resides in same county as the hospital
  - percent of stays for rural beneficiaries (non-SMSA residence)
  - percent of stays in rural hospitals
  - percent of rural beneficiaries admitted to hospitals in urban areas
  - percent of rural hospital admits transfered to other hospitals
  - percent of rural beneficiaries transferred to other hospitals
  - percent of urban beneficiaries transferred to other hospitals
  - average number of inpatient days (sample stay plus any transfer or readmit or rehospitalization days) within the 30-day post period for rural beneficiaries
  - average number of inpatient days for urban beneficiaries
  - average physician reimbursement (inpatient plus office) for the period 30 days pre to 30 days post stay for rural beneficiaries
  - average inpatient physician reimbursement for urban beneficiaries
  - percent of rural beneficiaries in rural hospitals using SNF or HHA services in the post 7-day period
  - percent of urban beneficiaries going to urban hospitals using SNF or HHA services in the post 7-day period
  - percent of rural beneficiaries going to urban hospitals using SNF or HHA services in the post 7-day period.

- Inter-Hospital Differences

  Four mutually exclusive groups of hospitals are defined:

  1. COTH members (heavy teaching)
  2. if not, government hospitals;
  3. if neither 1 or 2, proprietary hospitals;
  4. the remainder -- nonprofit hospitals.

  For each type of hospital we report data on the following measures:

  - average LOS
  - percent of beneficiaries using SNF or HHA within 7 days of discharge
  - ratio of physician reimbursement (30 days pre to 30 days post) to hospital reimbursement for the stay
  - percent of beneficiaries transferred to another hospital
  - percent of episode reimbursement (pre 30 days to post 30 days) for services in the post 30 days
  - total episode reimbursement (pre 30 to post 30)

2.5 Statistical Issues

We attempt only one type of statistical inference in the paper. For each measure and each tracer category we test:

H_0: The mean for the 1981-83 period is not different than the mean for the 1984-86 period

We report the probability (p) that the two means differ (two-sided test) on each table.

We offer no global test on whether the "episode" practice pattern is changing; the practice pattern is a multi-dimensional construct. We do explore a technique developed by Chernoff (1973), wherein graphical techniques are used to construct "faces" that are composed of 11 features or parameters--each corresponding to a use measure (LOS, transfer rate, etc.). These faces are used to describe pairs of 1981 and 1986 values on the 11 practice pattern variables to gauge the apparent differences between the two periods.

2.6 Data and Sampling Procedures

The samples were drawn from the 1981-1986 MEDPAR inpatient stay files for the 5% sample of Medicare beneficiaries. Five files were created that consist of episodes derived from a random sample of all hospital discharges and from a random sample of discharges in which there was a "tracer" diagnostic or procedure code present. The tracer categories are pneumonia, hip replacement, stroke and inguinal hernia. The general discharge episode file and the pneumonia and stroke files each contain 8,000 discharges per year. There were less than 8,000 hip replacement and hernia discharges each year, so all occurrences of these two tracer groups were included in the episode files.

Utilization records were drawn from the PPS Core Database files for five types of Medicare covered services: inpatient, skilled nursing facility, home health agency, outpatient, and Part B. The inpatient stay data are from the MEDPAR files; the SNF stay data are from the SNF stay files; and the HHA stay data are from the HHA Bill Record files. The two types of Part B utilization included in the files are hospital outpatient department utilization from the HDHIT 5% Part B Outpatient Bill Record files and non-institutional Part B utilization from the HDHIT 5% Part B Payment Record files. Beneficiary demographic data were drawn from the AAI Longitudinal Medicare eligibility file. Hospital provider data were drawn from the Medicare Provider of Service (POS) file and the AHA survey.

Part A and B data were "linked" in order to meet the definition of a discharge episode, the unit of observation. The episode window is defined to begin 60 days before the admission date and to end 60 days after the discharge date of the sampled inpatient stay. The pre-hospitalization period was divided into the entire 60 days before admission and the 30 days before admission. Pre-admission Part A and B utilization was aggregated into these two time periods. The post-hospitalization period was divided into the first 7 days, the first 14 days, the first 30 days and the first 60 days after the date of discharge. Post-discharge Part A and B services were aggregated into these time periods.

In addition to the quantitative utilization measures, there were also indicators of whether the patient was transferred to another hospital or was readmitted to the same or another hospital in the post-discharge period. The ICD-9-CM diagnostic and procedure codes from the sampled stay, from the first post-discharge rehospitalization, from the first SNF stay, and from the first HHA bill also were maintained in the episode record.

The file also contained characteristics of the beneficiary such as age, sex, race, date of death, and reason for and type of Medicare entitlement. Hospital data for the sampled inpatient provider such as the type of ownership, bedsize, teaching status, urban/rural location, and PPS start date were included in the file. Data for the SNF providing the greatest number of covered days of care and for the HHA providing the greatest number of visits in the post-discharge period were added to the file.

Other Part A and B utilization measures were accumulated for the episode as a whole. Detailed charge, reimbursement, diagnostic and procedure data for the first two inpatient stays in the episode also were maintained, as were similar data for the latest inpatient stay in the 90 day period prior to the start of the episode. Beneficiary characteristics, HHA provider data, and county-level descriptors similar to those in the discharge files also were added to the episode record.

For this analysis, subgroups were created for each tracer from the original tracer files in order to study groups of similar episodes. The tracers first were broken down into the DRGs that had the highest discharge rates: DRG 79, 80 (infections and inflammations) and DRG 89, 90 (simple pneumonias) for pneumonia, DRG 005 (surgery), DRG 014 (strokes), and DRG 015 (TIA) for stroke, DRG 161, 162 for hernia, and DRG 209 for hip replacement. In addition to these selected DRGs, primary diagnostic codes were combined to create the subgroups for hip replacement and hernia. The subgroups for hip replacement are DRG 209 and the "osteoarthrosis" ICD-9-CM codes and DRG 209 and the "fracture" ICD-9-CM codes. The subgroups studies for the hernia tracer group are DRG 161, 162 and the "complications" ICD-9-CM codes, i.e., hernias complicated by gangrene or obstructions, DRG 161, 162 and bilateral inguinal hernias, and DRG 161, 162 and unilateral inguinal hernias.

Another reason for narrowing our sample to the major DRG categories within each tracer was to eliminate the DRGs that were not related directly to the tracers we planned to study, i.e., DRG 038 (Primary Iris Procedures) appearing under the hip replacement tracer. Upon a review of these cases, we discovered that the reason for this occurrence was that secondary or tertiary diagnoses of one of the surgery codes was a hip replacement code. Because of these discrepancies, we decided to eliminate these DRGs from the study groups.

The last step was the elimination of persons who had acute inpatient care in the pre-30 day period. While this omits cases that are more severe, it also will result in more homogeneous study groups and omit persons for whom the sampled stay was subsequent to an initial stay for the episode of illness. Tables 3a-3d below show the initial and resultant sample sizes.

Prior to the creation of the tracer subgroups, three states were excluded from the original tracer samples. The source files received from HCFA were missing a number of claims that had been returned to the intermediaries for review and correction. These claims were not included on the files received from HCFA and consequently presented a potential for underreporting in particular states. Counts of the missing data were received from HCFA and, after review, we decided to exclude the states of Ohio, Kentucky and Pennsylvania.

2.7 Mortality

We included persons in our samples regardless of discharge status. We considered eliminating persons who were dead at discharge, but were concerned that the reduction in stay length might unduly bias the case selection process. We provide mortality data for each tracer group in Table 3e below.

There are two tracers where pre/post 1983 means are different enough to approach levels of statistical significance. For simple pneumonia (DRG 89/90), mortality at discharge is lower, probably reflecting shorter stays. Thirty-day post admission mortality is rising, though not by enough to reach acceptable confidence levels. This may reflect higher severity, though the admission rates for pneumonias are rising over the period making this unlikely. For strokes, death rates at discharge are also lower, probably relating to decreasing LOS. Mortality at 30 days post admission also seems to be lower. It seems doubtful that this is due to lower severity, although admission rates are tending to increase over the study period.

Table 3(a)

SUBTRACER SAMPLE SELECTION: PNEUMONIA

		1981	1982	1983	1984	1985	1986
TOTAL		8000	8000	8000	8000	8000	8000
% EXCLUDED STATES		26.37	23.35	24.45	24.39	25.75	26.25
SUBTOTAL EXCLUDED		2110	1868	1956	1951	2060	2100
% EXCLUDED DRG		1.43	1.63	2.10	2.03	2.07	2.15
SUBTOTAL EXCLUDED		2194	1968	2083	2074	2183	2227
% PRE-30 DAY		15.87	16.09	16.20	17.39	16.03	17.17
SUBTOTAL EXCLUDED		3129	2955	3062	3126	3135	3240
STUDY	DRG 79,80	76	75	125	354	412	438
GROUP	DRG 89,90	4809	4984	4841	4547	4476	4352
	TOTAL	4885	5059	4966	4901	4888	4790

Pneumonia tracer defined by the following diagnostic codes:

481 4810 48100 482XX 483 4830 48300 485 4850 48500 486 4860 48600

Table 3(b)

SUBTRACER SAMPLE SELECTION: STROKE

		1981	1982	1983	1984	1985	1986
TOTAL		8000	8000	8000	8000	8000	8000
% EXCLUDED STATES		27.14	26.92	27.22	26.64	27.42	27.25
SUBTOTAL EXCLUDED		2171	2154	2178	2131	2194	2180
% EXCLUDED DRG		3.72	3.73	4.00	3.08	3.01	2.35
SUBTOTAL EXCLUDED		2388	2372	2411	2312	2369	2317
% PRE-30 DAY		17.69	20.10	18.96	16.95	15.48	14.11
SUBTOTAL EXCLUDED		3419	3547	3515	3307	3268	3138
STUDY	DRG 015	259	315	293	335	325	306
GROUP	DRG 005	306	279	477	592	622	587
	DRG 014	4068	3919	3771	3799	3827	3991
	TOTAL	4633	4513	4541	4726	4774	4884

Stroke tracer defined by the following diagnostic codes:

431 4310 43100 433XX 434XX 436 4360 43600

Table 3(c)

SUBTRACER SAMPLE SELECTION: HIP REPLACEMENT

		1981	1982	1983	1984	1985	1986
TOTAL		2990	4271	5367	5834	6103	5307
% EXCLUDED STATES		27.62	26.69	24.28	24.22	24.69	25.19
SUBTOTAL EXCLUDED		826	1140	1303	1413	1507	1337
% EXCLUDED DRG		42.05	41.84	35.06	23.91	21.65	21.84
SUBTOTAL EXCLUDED		1736	2450	2728	2470	2502	2204
% PRE-30 DAY		7.09	8.81	9.13	8.48	7.16	6.75
SUBTOTAL EXCLUDED		1907	2726	3099	2845	2831	2472
	DRG 209:						
STUDY	OSTEO	516	690	991	1193	1311	1095
GROUP	FRACT	640	988	1443	1913	2072	1829
	TOTAL	1156	1678	2434	3106	3383	2924

Hip Replacement tracer defined by the following procedure codes:

815 8150 8151 8152 816 8160 8161 8162 8163 8164 8169

Table 3(d)

SUBTRACER SAMPLE SELECTION: HERNIA

		1981	1982	1983	1984	1985	1986
TOTAL		3699	4869	5839	6185	5329	4220
% EXCLUDED STATES		31.28	30.13	29.11	27.91	27.47	27.27
SUBTOTAL EXCLUDED		1157	1467	1700	1726	1464	1151
% EXCLUDED DRG		16.01	19.14	19.40	13.88	15.08	17.76
SUBTOTAL EXCLUDED		1564	2118	2503	2345	2047	1696
% PRE-30 DAY		4.29	4.79	4.40	4.39	4.35	3.94
SUBTOTAL EXCLUDED		1673	2281	2685	2541	2215	1817
	DRG 161,162:						
STUDY	COMPLIC	106	122	243	370	422	300
GROUP	BILAT	229	426	389	455	388	323
	UNILAT	1715	2079	2582	2873	2346	1810
	TOTAL	2050	2627	3214	3698	3156	2433

Inguinal Hernia tracer defined by the following procedure codes:

530X 531X

Table 3e

DEATH RATES

(Percent of Admissions)

	1981	1982	1983	1984	1985	1986	P-Value
PNEUMONIA							
DRG 79,80 (INFECT. & INFLAM.)							
AT DISCHARGE	11.8	17.3	22.4	19.8	20.1	15.5	.723
30 DAY POST ADMISSION	14.5	21.3	22.4	23.7	25.0	21.2	.223
DRG 89,90 (SIMPLE PNEUMONIA)							
AT DISCHARGE	11.0	10.0	10.5	9.3	9.4	10.2	.092
30 DAY POST ADMISSION	13.1	12.2	12.6	13.0	13.1	13.7	.110
STROKE							
DRG 005 (SURGERY)							
AT DISCHARGE	2.3	0.4	1.7	1.9	1.3	1.0	.937
30 DAY POST ADMISSION	2.3	0.4	2.3	1.9	1.4	1.0	.778
DRG 015 (TIA)							
AT DISCHARGE	2.7	2.2	1.7	1.8	2.5	1.0	.417
30 DAY POST ADMISSION	3.1	3.5	2.0	3.0	4.0	1.6	.997
DRG 014 (EXCEPT TIA)							
AT DISCHARGE	17.9	19.1	17.3	16.2	14.2	14.6	.018
30 DAY POST ADMISSION	20.9	21.3	19.9	20.0	18.3	18.7	.063
HIP REPLACE							
DRG 209 (OSTEO)							
AT DISCHARGE	0.4	0.6	0.3	0.5	0.3	1.0	.464
30 DAY POST ADMISSION	0.6	0.7	0.4	0.5	0.4	1.2	.675
DRG 209 (FRACTURES)							
AT DISCHARGE	3.1	3.6	4.8	4.4	3.1	3.2	.697
30 DAY POST ADMISSION	3.3	4.6	5.4	6.9	5.2	4.6	.287
HERNIA							
DRG 161,162 (BILATERAL)							
AT DISCHARGE	0.0	0.7	0.0	0.0	0.3	0.0	.584
30 DAY POST ADMISSION	0.0	1.2	0.8	0.0	0.5	0.0	.283
DRG 161,162 (UNILATERAL)							
AT DISCHARGE	0.1	0.1	0.2	0.1	0.2	0.2	.790
30 DAY POST ADMISSION	0.2	0.5	0.3	0.5	0.5	0.4	.391
DRG 161,162 (COMPLICATED)							
AT DISCHARGE	1.9	1.6	1.6	2.4	0.9	0.3	.482
30 DAY POST ADMISSION	3.8	2.5	2.1	2.7	1.4	1.7	.269

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED PER CAPITA ANALYSIS

3.0 STROKE EPISODES

Stroke episodes were subdivided into three groups: DRG 015 (TIA), DRG 005 (Extracranial surgery) and DRG 014 (stroke). These separate categories of cases are preserved in the tables that follow. The discussion follows the order of the seven groups of measures noted earlier:

- Features of Admitted Cases
- Use of Hospital Services
- Part B Service Use
- Post Hospital SNF and HHA Services
- Medicare Expenditures for the Episode
- Geographic Use Patterns
- Interhospital Differences

On each of the seven tables that follow we report the p-value for the difference of means between 1981-83 and 1984-86.

Features of Admitted Cases. There are clear patient differences across the three stroke subgroups; this fact supports the decision to partition. DRG 014 (stroke) patients are older, more apt to be nonwhite and female than the other groups. Persons with surgery (DRG 005) are observed to be more expensive to Medicare in the pre 30-day period. These data are shown in Table 3.1.

There have been some trends in the characteristics of admitted cases, more so for stroke and surgical cases than for TIAs. For the surgical (005) and stroke cases (014) there have been significant increases in the amount of Medicare spending in the pre 60-day period, and higher physician reimbursement in the pre 30-day period. In the case of strokes (014) these increases are significant at the $p = 0.10$ level but not at the $p = 0.05$ level. These increases may reflect higher severity or substitution of some care into the pre-stay period. For TIA admissions, we see a significant downward trend in the fraction of persons with hospital stays in the period 30-60 days before the focal stay (possibly reflecting lower general admission rates for Medicare or a result of coding unprecision in the early years).

The fact that most measures do not show large and significant trends lends support to the view that admitting patterns for these cases are not changing in radical

Table 3.1

FEATURES OF ADMITTED CASES: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	73.054	72.041	73.055	72.860	74.298	73.075	0.283
% FEMALE	0.440	0.489	0.481	0.499	0.526	0.471	0.268
% NON-WHITE	0.097	0.089	0.065	0.090	0.095	0.095	0.370
BENEFICIARY MEDICARE STATUS CODE=AGED	0.934	0.879	0.932	0.913	0.963	0.935	0.395
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.004	0.000	0.003	0.000	0.000	0.000	0.118
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.015	0.006	0.031	0.027	0.031	0.013	0.533
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	49.417	70.205	82.533	82.030	78.124	79.626	0.267
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.085	0.076	0.075	0.072	0.065	0.062	0.041
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	98.154	104.814	149.664	136.709	135.917	128.738	0.377

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	71.451	71.864	72.178	71.909	72.781	71.836	0.404
% FEMALE	0.392	0.459	0.461	0.485	0.468	0.445	0.327
% NON-WHITE	0.029	0.047	0.063	0.061	0.068	0.066	0.133
BENEFICIARY MEDICARE STATUS CODE=AGED	0.935	0.925	0.910	0.944	0.936	0.940	0.089
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.000	0.000	0.002	0.002	0.005	0.003	0.085
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.010	0.011	0.023	0.025	0.027	0.020	0.106
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	76.493	83.762	96.201	117.629	143.663	151.188	0.011
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.160	0.129	0.145	0.142	0.141	0.138	0.671
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	112.725	127.581	157.208	184.042	217.156	226.928	0.014

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	76.694	77.050	77.107	77.553	77.446	77.413	0.019
% FEMALE	0.550	0.560	0.566	0.564	0.576	0.575	0.104
% NON WHITE	0.156	0.147	0.165	0.173	0.156	0.162	0.351
BENEFICIARY MEDICARE STATUS CODE=AGED	0.946	0.946	0.953	0.962	0.955	0.958	0.037
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.003	0.007	0.005	0.007	0.005	0.004	0.830
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.043	0.053	0.058	0.054	0.060	0.052	0.425
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	44.331	38.049	43.285	43.888	54.797	50.992	0.099
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.068	0.072	0.074	0.066	0.070	0.065	0.114
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	93.035	98.331	106.967	108.153	123.335	109.286	0.090

ways. This improves the chances that changes in use patterns described below are representative of changes in practice patterns rather than patient severity.

Use of Hospital Services. Table 3.2 describes trends in selected measures of inpatient use for stroke patients. There are clear differences in use patterns across the three DRGs: stroke (014) having the longest LOS, higher transfer and rehospitalization rates and most intensive use of ICCU services.

Virtually all inpatient use measures for all groups have changed over the pre/post PPS period; the exception is rehospitalization rates (admits to other hospitals within 7 days of discharge). Length of stays are down (about 25% for stroke and about 35% for surgical cases and TIAs). About half the large drop in LOS for the surgical DRG is due to cuts over the 1981-86 interval in presurgical days (down from 4.5 to 2.5 days). External transfer rates are lower for this DRG as well; external transfers are unchanged for the other two DRGs. ICCU usage is down for TIAs, and higher for surgical and stroke cases. Ancillary intensity is higher in all groups. Readmission rates are about doubled for the stroke group, and unchanged for the others.

Part B Service Use. Table 3.3 shows Part B service use measures. Part B payments are generally much greater for the surgical DRG (005) due to surgical and anesthesia fees. For a 30-day pre/post stroke episode (014) physician payments in 1986 are about $450 (1981 dollars), about $630 for TIAs, and about $1600 for DRG 005. These differences are much less marked than in 1981; $470, $1040, and $2230 respectively. Many measures have changed markedly, reflecting a general pattern of substitution of outpatient for inpatient care. Physician inpatient payments for all three types of cases have fallen relative to general medical care price levels, due in large part to the fee freeze and reduced LOS. Payments for office-based MD services have remained flat in real terms, probably resulting from more units of service in the face of the fee freeze. Unlike the other two groups, office reimbursments for stroke are significantly higher and the ratio of inpatient to office physician patients is lower--no doubt reflecting increases in office visits relative to inpatient visits during the pre 30- to post 30-day window. For all three stroke tracers, there is a reduction in the ratio of physician to hospital payments; this reduction is significant only for the surgical DRG (005).

Interestingly, use of OPD services for these tracers is lower over the 30 day pre-post window. ER visits are fairly flat except for TIAs, where they are higher. There is a general increase in the intensity of procedural use (as opposed to cognitive service) of OPDs in all three groups. DME use is also higher for all groups.[1]

Table 3.2

USE OF HOSPITAL SERVICES: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	7.089	7.683	6.631	4.964	4.508	4.474	0.002
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.031	0.044	0.044	0.039	0.025	0.049	0.787
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.003	0.006	0.003	0.015
INT & COR CARE UNIT DAYS > 0	0.208	0.235	0.140	0.087	0.083	0.124	0.037
TOT ANCIL CHARGES / TOTAL CHARGES	0.601	0.633	0.636	0.656	0.659	0.693	0.048
# READMISSIONS W/IN 7 DAY POST PERIOD	0.066	0.098	0.116	0.093	0.074	0.052	0.337
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.046	0.057	0.055	0.057	0.031	0.062	0.795

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	11.660	10.957	10.170	9.402	7.936	7.368	0.022
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.013	0.011	0.013	0.007	0.006	0.009	0.007
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.002	0.003	0.003	0.005	0.026
INT & COR CARE UNIT DAYS > 0	0.784	0.781	0.849	0.834	0.841	0.845	0.190
TOT ANCIL CHARGES / TOTAL CHARGES	0.632	0.633	0.648	0.664	0.685	0.701	0.019
# READMISSIONS W/IN 7 DAY POST PERIOD	0.026	0.047	0.048	0.024	0.035	0.036	0.344
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.016	0.014	0.017	0.015	0.010	0.015	0.296

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	12.688	13.571	12.821	10.662	9.527	9.585	0.003
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.048	0.056	0.060	0.059	0.051	0.054	0.972
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.001	0.017	0.037	0.033	0.010
INT & COR CARE UNIT DAYS > 0	0.181	0.198	0.200	0.211	0.222	0.249	0.057
TOT ANCIL CHARGES / TOTAL CHARGES	0.483	0.496	0.508	0.523	0.549	0.570	0.028
# READMISSIONS W/IN 7 DAY POST PERIOD	0.030	0.030	0.033	0.047	0.073	0.061	0.018
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.053	0.066	0.067	0.069	0.060	0.064	0.681

Table 3.3

PART B SERVICES: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	988.000	1209.420	942.969	786.772	692.545	568.417	0.025
MD OFFICE REIMB-(30-30)	56.359	43.207	62.904	56.200	66.880	61.773	0.319
RATIO OF MD REIMB. TO INPAT (30-30)	1.892	1.782	4.516	1.144	0.815	0.855	0.117
% WITH DME (30-30)	0.058	0.054	0.072	0.057	0.111	0.098	0.187
OPD CLINIC VISITS (30-30)	0.075	0.103	0.095	0.063	0.037	0.062	0.034
ER CLINIC VISITS (30-30)	0.108	0.076	0.085	0.123	0.136	0.193	0.060
% WITH OPD BILLS W/SURG (30-30)	0.004	0.000	0.017	0.024	0.046	0.046	0.025

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	2143.529	2064.333	2064.821	1862.775	1748.354	1513.081	0.023
MD OFFICE REIMB-(30-30)	85.958	71.297	74.805	82.762	87.775	80.585	0.265
RATIO OF MD REIMB. TO INPAT (30-30)	0.874	0.853	0.870	0.829	0.456	0.448	0.084
% WITH DME (30-30)	0.036	0.050	0.065	0.069	0.088	0.058	0.154
OPD CLINIC VISITS (30-30)	0.125	0.100	0.061	0.062	0.077	0.044	0.177
ER CLINIC VISITS (30-30)	0.115	0.115	0.088	0.098	0.107	0.129	0.687
% WITH OPD BILLS W/SURG (30-30)	0.003	0.004	0.008	0.034	0.051	0.089	0.031

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	439.435	493.082	475.995	436.755	415.740	390.870	0.056
MD OFFICE REIMB-(30-30)	30.422	32.071	35.589	39.521	47.852	45.095	0.017
RATIO OF MD REIMB. TO INPAT (30-30)	0.350	0.389	0.500	0.489	0.257	0.304	0.497
% WITH DME (30-30)	0.182	0.190	0.213	0.234	0.241	0.225	0.020
OPD CLINIC VISITS (30-30)	0.086	0.053	0.055	0.039	0.043	0.044	0.103
ER CLINIC VISITS (30-30)	0.131	0.095	0.113	0.104	0.134	0.148	0.406
% WITH OPD BILLS W/SURG (30-30)	0.004	0.004	0.007	0.013	0.024	0.029	0.021

Description of Selected Variables:

MD Inpatient Service Reimb. (30-30) = Part B Inpatient Reimb. Amt. Pre 30 to Post 30

MD Office Reimb. (30-30) = Part B Physician Reimb. Amt. Pre 30 day and Post 30 day periods.

Ratio of MD Reimb. to Inpat. (30-30) = (MD Inpat. Service Reimb. + MD Office Reimb.)/Hospital Inpat. Stay Reimb.

Post Hospital SNF and HHA Use. Table 3.4 shows several measures of admission rates and intensity of HHA and SNF services. Post discharge use is clearly much higher for stroke (014) than the other two tracers; use of SNF benefits are tenfold higher, and use of HHA services are 3 to 4 times higher.

There is clear evidence that use of SNF and HHA services are higher after 1983. SNF use is up for only stroke (014); with rates of SNF admissions going from about 11% of all discharges to over 13%. All measures of HHA use are up for all three tracers. For TIAs, about 4% got HHA services within 7 days of discharge in the early 1980s--and slightly less than 6% got services in 1986. For the surgical DRG the change has been from 3.5% to 5.5-6%. For stroke the 7-day access rate is up from about 10% to about 16%. In all cases the increase is about 50% of the base rate.

Overall 7-day post hospital care (HHA, SNF) access rate is higher for all tracers, though the increase is not statistically significant for TIAs. This measure shows larger differences across tracers; about 28% of stroke (014) patients receive such services within 7 days of discharge, while only about 7% of the other patients receive such services.

Intensity of home health use has changed for DRG 005 and 014. For DRG 005 we see a richer mix of skilled nursing and higher rates of therapists. For stroke (014), discharged patients are receiving more therapist visits, but there has been a reduction in the fraction of HHA visits delivered by RNs.

The accompanying figure (3.1) describes home health use post discharge in more detail. The left panel shows the likelihood of a beneficiary initiating HHA care in any week in 1981 and 1986. These charts are to be interpreted as hazard rates; how does the intervention of a hospital stay alter the likelihood of HHA use? These figures show that for all 3 tracers, post (1986) period access is different in only one way; the likelihood of using HHA care is higher in the first week post discharge. For other points in time, there basically is no change in HHA access rates (though the background access rate is possibly slightly higher in 1981).

The right side of the chart shows intensity of HHA visits per week, for persons using at least 1 visit. The basic finding is that intensity is up in all cases in the first week post discharge, and everywhere higher, except for TIAs.

Expenditures. Table 3.5 summarizes Medicare reimbursements for the period

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[1] The tracer files do not include a categorization of DME usage. However, DME for stroke typically includes walking aids, wheelchairs and hospital beds and patient lifts for more severe paralyses.

Table 3.4

POST HOSPITAL SERVICES: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.008	0.016	0.024	0.018	0.015	0.016	0.887
# COVERED SNF DAYS IN POST 30 PERIOD	0.251	0.517	0.577	0.442	0.209	0.317	0.356
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.046	0.035	0.048	0.045	0.058	0.056	0.163
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.050	0.041	0.048	0.051	0.065	0.062	0.064
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.050	0.044	0.061	0.063	0.095	0.069	0.104
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.069	0.057	0.072	0.078	0.105	0.085	0.068
TOTAL # HHA VISITS IN POST 7 PERIOD	0.119	0.059	0.143	0.176	0.199	0.246	0.037
TOTAL # HHA VISITS IN POST 14 PERIOD	0.264	0.118	0.252	0.353	0.411	0.431	0.023
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.610	0.772	0.675	0.694	0.485	0.610	0.308
# HHA THERAPY VISITS IN POST 14 PERIOD	0.015	0.010	0.024	0.018	0.034	0.020	0.316
POST HOSP CARE RATE IN POST 7 PERIOD	0.054	0.051	0.068	0.063	0.071	0.072	0.153

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.013	0.007	0.008	0.008	0.008	0.012	0.975
# COVERED SNF DAYS IN POST 30 PERIOD	0.242	0.054	0.189	0.201	0.156	0.305	0.453
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.033	0.036	0.038	0.066	0.064	0.053	0.004
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.036	0.039	0.040	0.068	0.076	0.058	0.005
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.049	0.047	0.050	0.091	0.087	0.068	0.010
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.062	0.054	0.059	0.100	0.101	0.087	0.002
TOTAL # HHA VISITS IN POST 7 PERIOD	0.154	0.128	0.154	0.231	0.232	0.202	0.005
TOTAL # HHA VISITS IN POST 14 PERIOD	0.299	0.245	0.300	0.480	0.474	0.367	0.018
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.488	0.543	0.467	0.518	0.612	0.581	0.117
# HHA THERAPY VISITS IN POST 14 PERIOD	0.016	0.014	0.021	0.037	0.026	0.024	0.064
POST HOSP CARE RATE IN POST 7 PERIOD	0.046	0.043	0.046	0.074	0.071	0.065	0.001

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.107	0.106	0.115	0.134	0.134	0.130	0.002
# COVERED SNF DAYS IN POST 30 PERIOD	2.469	2.418	2.619	2.935	2.834	2.609	0.063
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.094	0.124	0.141	0.150	0.162	0.155	0.067
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.108	0.135	0.155	0.164	0.178	0.169	0.059
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.126	0.156	0.180	0.195	0.206	0.206	0.039
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.157	0.184	0.213	0.236	0.242	0.241	0.028
TOTAL # HHA VISITS IN POST 7 PERIOD	0.290	0.401	0.505	0.561	0.656	0.658	0.032
TOTAL # HHA VISITS IN POST 14 PERIOD	0.607	0.833	1.011	1.139	1.334	1.274	0.030
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.524	0.505	0.478	0.463	0.471	0.460	0.053
# HHA THERAPY VISITS IN POST 14 PERIOD	0.059	0.077	0.099	0.104	0.114	0.111	0.059
POST HOSP CARE RATE IN POST 7 PERIOD	0.200	0.229	0.254	0.280	0.291	0.282	0.025

Figure 3.1

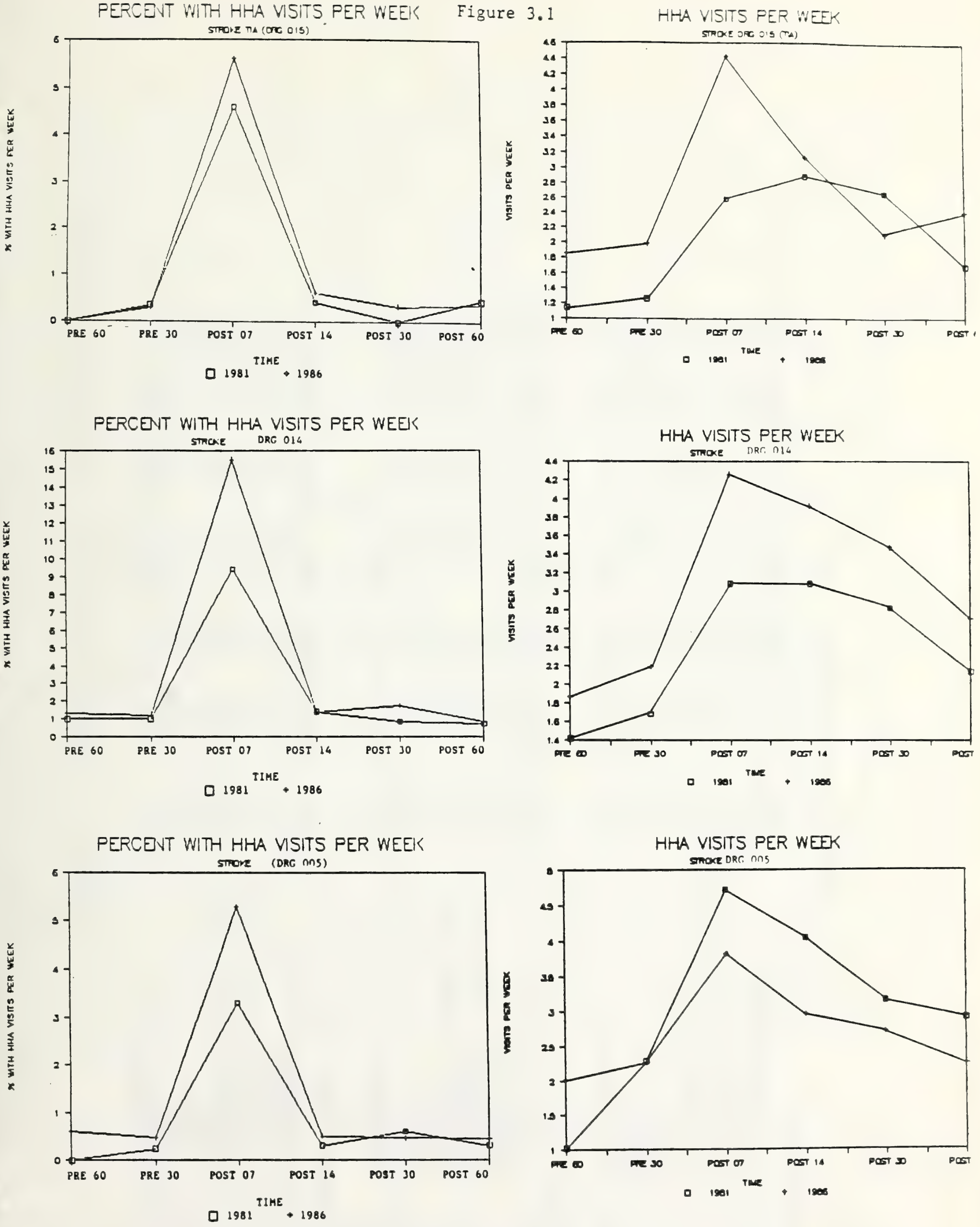
PERCENT WITH HHA VISITS PER WEEK
STROKE TIA (DRG 015)
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
STROKE DRG 015 (TIA)
VISITS PER WEEK
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
4.6
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST
TIME
□ 1981
+ 1986
PERCENT WITH HHA VISITS PER WEEK
STROKE DRG 014
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
STROKE DRG 014
VISITS PER WEEK
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
4.4
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST
TIME
□ 1981
+ 1986
PERCENT WITH HHA VISITS PER WEEK
STROKE (DRG 005)
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
STROKE DRG 005
VISITS PER WEEK
1
1.5
2
2.5
3
3.5
4
4.5
5
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST
TIME
□ 1981
+ 1986

Table 3.5

EXPENDITURES & INTENSITY OF EPISODE: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	3622.799	4335.926	3856.622	3904.844	3447.198	2990.947	0.219
% EPI REIMB PRE	0.043	0.038	0.062	0.051	0.049	0.054	0.659
% EPI REIMB POST	0.113	0.162	0.185	0.226	0.181	0.166	0.245
% EPI REIMB POST (EX REHOSP & READM)	0.035	0.031	0.041	0.041	0.045	0.044	0.072
% EPI INPATIENT	0.844	0.800	0.753	0.723	0.769	0.780	0.261
% EPI INPATIENT (INC REHOSP & READM)	0.922	0.931	0.896	0.907	0.906	0.902	0.342
% EPI MD	0.333	0.310	0.294	0.225	0.210	0.210	0.001
% EPI PART B	0.359	0.331	0.324	0.253	0.243	0.244	0.001
% EPI HHA	0.006	0.002	0.009	0.009	0.012	0.008	0.199
% EPI SNF	0.003	0.004	0.007	0.005	0.004	0.004	0.639
AMOUNT REIMBURSED	1856.946	2143.213	1678.685	1529.229	1483.035	1266.457	0.042

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	6377.271	6287.780	6049.436	6671.020	6811.069	5973.919	0.422
% EPI REIMB PRE	0.019	0.026	0.030	0.030	0.032	0.038	0.105
% EPI REIMB POST	0.058	0.065	0.056	0.065	0.068	0.062	0.196
% EPI REIMB POST (EX REHOSP & READM)	0.015	0.013	0.019	0.018	0.018	0.017	0.287
% EPI INPATIENT	0.923	0.909	0.913	0.905	0.900	0.900	0.040
% EPI INPATIENT (INC REHOSP & READM)	0.965	0.961	0.951	0.952	0.950	0.945	0.093
% EPI MD	0.399	0.374	0.384	0.306	0.271	0.264	0.002
% EPI PART B	0.408	0.385	0.399	0.320	0.285	0.281	0.002
% EPI HHA	0.003	0.003	0.004	0.006	0.005	0.004	0.097
% EPI SNF	0.001	0.000	0.001	0.002	0.002	0.002	0.046
AMOUNT REIMBURSED	3521.958	3408.392	3335.390	4005.834	4145.212	3645.036	0.032

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	4246.215	4686.216	4711.508	4679.076	4799.275	4338.653	0.792
% EPI REIMB PRE	0.037	0.038	0.038	0.027	0.026	0.026	0.000
% EPI REIMB POST	0.125	0.139	0.146	0.152	0.160	0.162	0.038
% EPI REIMB POST (EX REHOSP & READM)	0.060	0.063	0.068	0.066	0.068	0.072	0.153
% EPI INPATIENT	0.838	0.823	0.816	0.820	0.813	0.812	0.213
% EPI INPATIENT (INC REHOSP & READM)	0.903	0.899	0.894	0.907	0.905	0.902	0.120
% EPI MD	0.143	0.142	0.137	0.102	0.090	0.094	0.000
% EPI PART B	0.172	0.172	0.167	0.124	0.111	0.116	0.000
% EPI HHA	0.014	0.020	0.022	0.022	0.024	0.024	0.146
% EPI SNF	0.021	0.021	0.023	0.025	0.025	0.027	0.010
AMOUNT REIMBURSED	2973.443	3210.410	3196.817	3066.593	3100.589	2761.009	0.319

spanning 30 days pre admission to 30 days post discharge. Total episode payments basically are unchanged against the DRI Medical Care Price Index for all three tracers. Episode costs for DRG 005 continues to be about twice as high as TIAs, with stroke in the middle. In real terms, hospital reimbursement for the focal stay (Amount Reimbursed) has fallen for TIAs and surgery and remained about the same for stroke. Episode payments remain dominated (over 90%) by costs incurred during the stay (both Part A and Part B) and this percentage is relatively unchanged.

Two definitions of post-hospital costs are shown. The first shows all reimbursements in the 30 days post discharge, including subsequent hospital stays. On this measure there has been an increase for only the stroke (014) cases. The other measure of post reimbursements excludes inpatient care. Increases in this measure are observed for only TIAs.

The fraction of episode payments going to Part B and to physicians both have fallen for all three tracers. HHA and SNF shares have increased for all three groups, but the importance of these services remains very small; together about 1% for TIAs, even less for DRG 005, and 4-5% for stroke.

Figure 3.2 shows the distributions of episode spending for stroke (014) for 1981 and 1986. The figure suggests that there has been a marked compression of reimbursement amounts in 1986, much more tightly centered around a value about 75% of the mean. There are also fewer cases in the extreme right (outlier) tail; over $16,000 per episode.

The accompanying Figure 3.3 shows spending per week for each segment of the episode (except the focal inpatient stay). All reimbursements are in 1981 dollars. Three groupings of services are shown; Part B except DME; HHA, SNF and DME; and, hospital.[1] The bottom right panel is the total. Generally, we see little difference between 1981 and 1986 in pre stay spending; in the post period we see a sharp increase in spending in the first week post discharge, which drops much closer to the 1981 weekly spending level by the 60th post hospital day. The exception is the MD/OPD category, which peaks in the first week post discharge, but does not converge toward 1981 spending levels by the 60th day.

Geographic Use Patterns. Table 3.6 describes the geographic structure of admissions and several use measures for beneficiaries in urban (SMSA) and rural areas.

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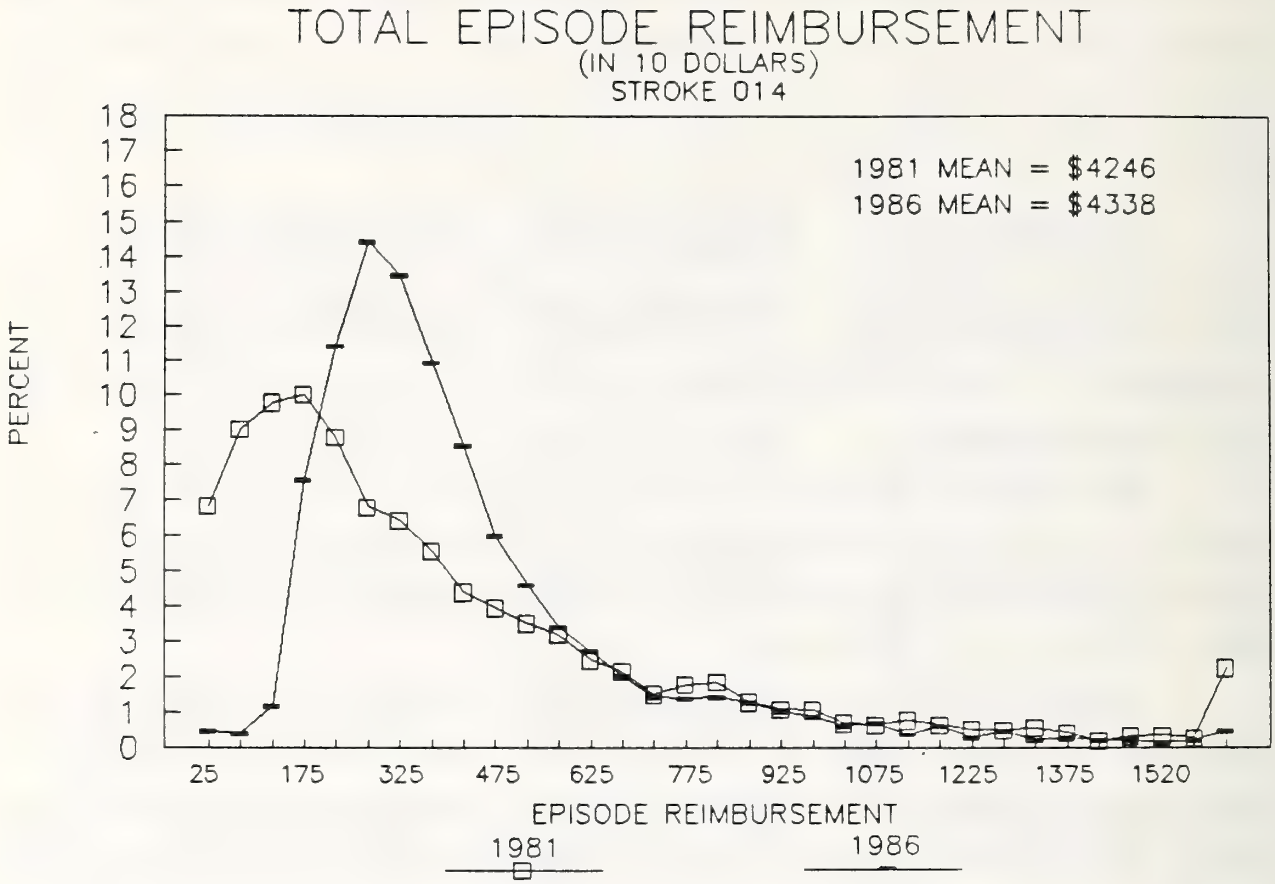
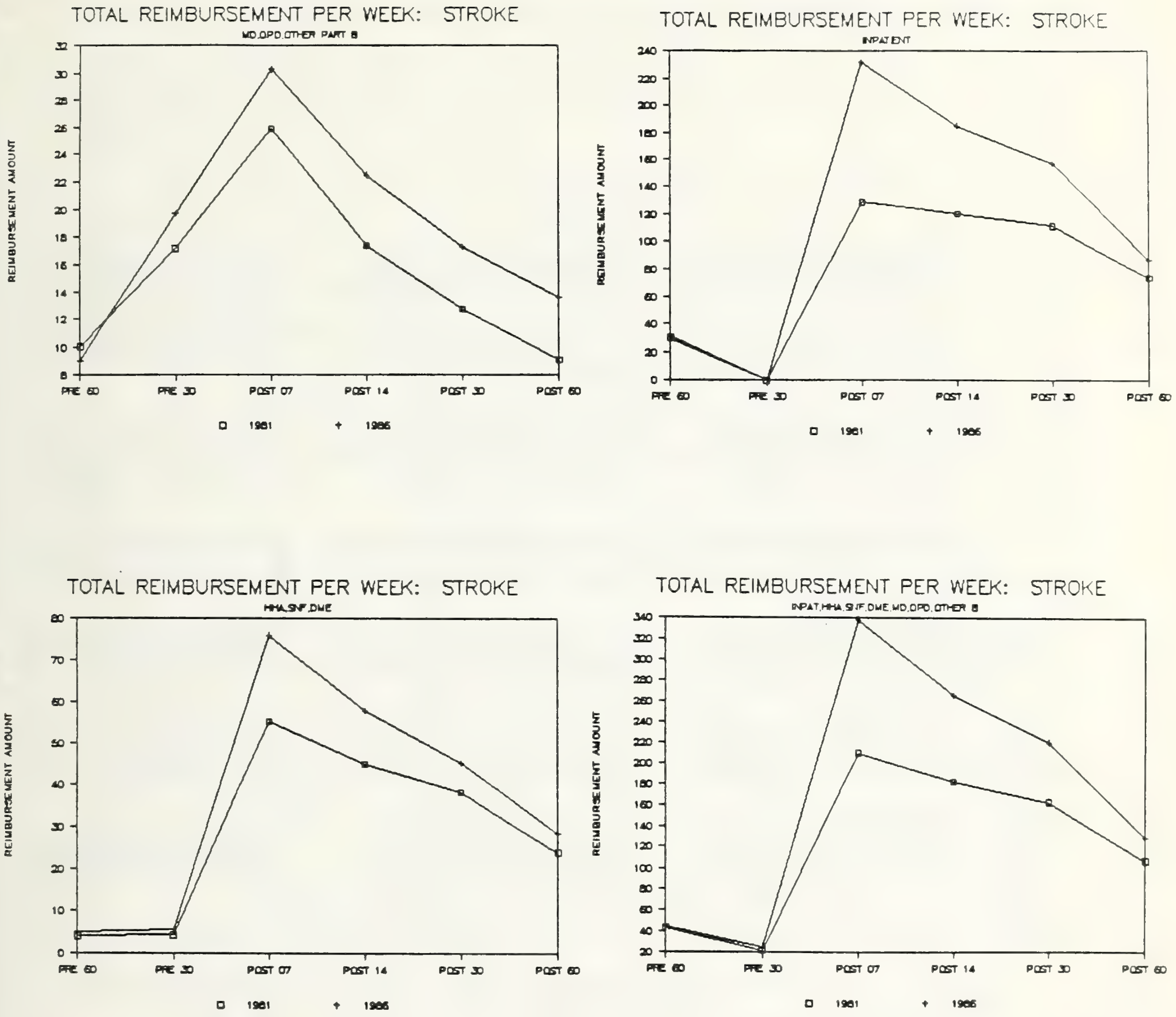
[1] Note that hospital spending in the pre 30-day period is zero; this stems from our sampling procedure, which eliminated persons who had stays in the pre 30-day period.

Figure 3.2



TOTAL EPISODE REIMBURSEMENT
(IN 10 DOLLARS)
STROKE 014
1981 MEAN = $4246
1986 MEAN = $4338
PERCENT
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
25
175
325
475
625
775
925
1075
1225
1375
1520
EPISODE REIMBURSEMENT
1981
1986

Figure 3.3


TOTAL REIMBURSEMENT PER WEEK: STROKE
MD,OPD,OTHER PART B

TOTAL REIMBURSEMENT PER WEEK: STROKE
INPATIENT

TOTAL REIMBURSEMENT PER WEEK: STROKE
HHA,SNF,DME

TOTAL REIMBURSEMENT PER WEEK: STROKE
INPAT,HHA,SNF,DME,MD,OPD,OTHER B

Table 3.6

GEOGRAPHIC USE PATTERNS: STROKE

DRG 015 (TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.676	0.673	0.645	0.648	0.640	0.670	0.417
% RURAL RESIDENCE	0.270	0.298	0.338	0.349	0.354	0.333	0.103
% IN RURAL HOSPITALS	0.104	0.114	0.137	0.158	0.194	0.203	0.016
% RURAL BENEF IN URBAN HOSPITALS	0.628	0.638	0.606	0.590	0.487	0.412	0.072
RURAL EXT TRANSFERS(HOSP)	0.111	0.083	0.050	0.075	0.048	0.145	0.827
RURAL BENE EXT TRANS	0.057	0.032	0.030	0.051	0.026	0.069	0.588
URBAN BENE EXT TRANS	0.022	0.050	0.052	0.032	0.024	0.039	0.436
RURAL DAYS OF CARE	7.100	7.266	6.899	5.291	4.600	5.451	0.002
URBAN DAYS OF CARE	7.527	8.356	7.760	5.519	5.205	4.946	0.001
RURAL MD REIMB	1126.629	1111.976	918.844	769.496	687.528	614.095	0.011
URBAN MD REIMB	944.355	1244.936	951.618	802.657	695.292	548.266	0.042
RURAL 7 DAY PHC RATE	0.000	0.000	0.103	0.083	0.051	0.067	0.408
URBAN 7 DAY PHC RATE	0.065	0.060	0.079	0.066	0.087	0.080	0.292
RURAL/URBAN 7 DAY PHC RATE	0.042	0.048	0.016	0.039	0.033	0.044	0.714

DRG 005 (SURGERY)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.654	0.649	0.662	0.611	0.611	0.630	0.008
% RURAL RESIDENCE	0.288	0.251	0.291	0.323	0.330	0.330	0.018
% IN RURAL HOSPITALS	0.078	0.072	0.103	0.101	0.122	0.133	0.059
% RURAL BENEF IN URBAN HOSPITALS	0.727	0.714	0.691	0.707	0.668	0.618	0.171
RURAL EXT TRANSFERS(HOSP)	0.042	0.000	0.061	0.000	0.000	0.013	0.181
RURAL BENE EXT TRANS	0.023	0.029	0.022	0.016	0.010	0.005	0.020
URBAN BENE EXT TRANS	0.009	0.005	0.009	0.003	0.005	0.010	0.541
RURAL DAYS OF CARE	12.386	11.757	9.597	9.885	7.654	7.639	0.064
URBAN DAYS OF CARE	11.839	10.913	10.807	9.402	8.296	7.548	0.012
RURAL MD REIMB	1991.523	2033.042	1807.981	1720.653	1546.679	1409.851	0.027
URBAN MD REIMB	2204.890	2080.800	2177.162	1928.346	1846.854	1564.066	0.033
RURAL 7 DAY PHC RATE	0.083	0.000	0.023	0.125	0.044	0.095	0.201
URBAN 7 DAY PHC RATE	0.046	0.048	0.055	0.076	0.081	0.075	0.001
RURAL/URBAN 7 DAY PHC RATE	0.031	0.039	0.029	0.049	0.054	0.016	0.614

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.769	0.789	0.786	0.785	0.767	0.760	0.335
% RURAL RESIDENCE	0.381	0.367	0.363	0.377	0.358	0.373	0.891
% IN RURAL HOSPITALS	0.321	0.316	0.309	0.327	0.301	0.308	0.702
% RURAL BENEF IN URBAN HOSPITALS	0.224	0.194	0.201	0.195	0.217	0.232	0.585
RURAL EXT TRANSFERS(HOSP)	0.061	0.072	0.081	0.076	0.065	0.071	0.915
RURAL BENE EXT TRANS	0.052	0.069	0.076	0.066	0.060	0.061	0.639
URBAN BENE EXT TRANS	0.045	0.049	0.051	0.053	0.046	0.050	0.680
RURAL DAYS OF CARE	12.628	13.688	12.728	10.758	9.302	9.757	0.005
URBAN DAYS OF CARE	14.490	15.460	14.973	12.524	11.171	11.348	0.003
RURAL MD REIMB	313.517	331.633	343.720	314.607	291.832	289.266	0.060
URBAN MD REIMB	518.608	590.314	551.598	510.635	484.739	451.460	0.057
RURAL 7 DAY PHC RATE	0.122	0.157	0.178	0.218	0.253	0.274	0.014
URBAN 7 DAY PHC RATE	0.242	0.268	0.300	0.316	0.318	0.291	0.107
RURAL/URBAN 7 DAY PHC RATE	0.178	0.205	0.194	0.252	0.231	0.249	0.007

The fraction of cases where beneficiary residence is rural is definitely up for TIAs and surgical cases (not so for stroke); this reflects much better access for rural persons relative to urban counterparts. It also appears that rural (non-SMSA) hospitals are keeping that business; there is no evidence of an increase in the fraction of rural beneficiaries admitted to urban hospitals.

Days of care (focal stay plus transfer and readmit days) are falling in both urban and rural hospitals through 1985, with slight increases in 1986. Total days are still slightly higher in rural hospitals for DRG 005, and lower for the other two tracers. Transfer rates are generally higher for rural hospitals--but no trend is evident in transfer rates in either location.

Physician inpatient reimbursements are not much different in urban and rural settings for TIAs and surgery, but are much higher in urban hospitals for stroke. These payments are clearly trending down against medical care inflation in both settings for all three tracers.

Urban/rural differences and trends are not evident for TIAs. Trends in use are up for DRG 005. For strokes (where the number of study cases is largest) the patterns are more interesting. Prior to 1985, urban persons admitted to urban hospitals had about twice the chance of getting SNF or HHA services in the post 7-day period as did rural persons admitted to rural hospitals. Rural residents going to urban hospitals were in the middle. While the trend in post-hospital care access rates is higher for all three of these groups, there is a clear compression in access, with the most rapid increases seen for rural hospital patients. Now, the least access is provided to rural beneficiaries going to urban hospitals.[1]

Inter Hospital Differences. Table 3.7 presents means for several use and spending measures by type of hospital. Data for only DRG 014 (stroke) are presented here because of limiting sample sizes for the other groups of cases.

Since 1983, LOS declined in all hospital types to 1985--in 1986 LOS increased for all except proprietary hospitals, where the trend continued. External transfer rates continue to be highest for proprietary and government hospitals, but no trends in these rates are seen. The ratio of office to inpatient reimbursement for MDs continues to be highest for these same types of hospitals, with no significant trends.

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[1] In case studies done in 10 communities in 1986 for HCFA by Abt and HER, the respondent discharge planners suggested that this "travelling" group presented the most difficult access threat for quickly engaging needed services back in the community of residence.

Table 3.7

INTER HOSPITAL DIFFERENCES IN EPISODE: STROKE

DRG 014 (EXCEPT TIA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LOS FOR HEAVY TEACHING	14.601	14.331	15.730	11.103	11.082	10.748	0.001
LOS FOR GOVERNMENT	11.311	13.071	11.460	9.265	8.267	8.534	0.007
LOS FOR PROPREITARY	11.620	12.672	12.092	10.709	9.653	9.071	0.015
LOS FOR NON-PROFIT	13.238	13.865	13.245	11.076	9.796	10.186	0.002
SOME PHC IN 7 DAYS,TEACHING	0.220	0.338	0.322	0.310	0.286	0.311	0.828
SOME PHC IN 7 DAYS,GOVERNMENT	0.134	0.191	0.206	0.246	0.274	0.248	0.028
SOME PHC IN 7 DAYS,PROPREITARY	0.211	0.252	0.280	0.324	0.372	0.298	0.047
SOME PHC IN 7 DAYS,NON-PROFIT	0.220	0.231	0.263	0.281	0.280	0.285	0.028
RATIO OF MD REIMB TO INPAT,TEACHING	0.175	0.283	0.171	0.101	0.109	0.172	0.127
RATIO OF MD REIMB TO INPAT,GOVERNMENT	0.443	0.387	0.408	0.590	0.432	0.399	0.377
RATIO OF MD REIMB TO INPAT,PROPREITARY	0.386	0.435	0.601	1.010	0.279	0.268	0.867
RATIO OF MD REIMB TO INPAT,NON-PROFIT	0.323	0.387	0.529	0.379	0.207	0.294	0.202
% WITH EXTERNAL TRANSFERS,TEACHING	0.030	0.022	0.070	0.024	0.061	0.046	0.864
% WITH EXTERNAL TRANSFERS,GOVERNMENT	0.053	0.077	0.085	0.078	0.069	0.062	0.869
% WITH EXTERNAL TRANSFERS,PROPREITARY	0.047	0.085	0.080	0.072	0.048	0.046	0.350
% WITH EXTERNAL TRANSFERS,NON-PROFIT	0.047	0.046	0.047	0.052	0.044	0.055	0.376
% EPI COST POST,TEACHING	0.082	0.158	0.152	0.123	0.171	0.155	0.535
% EPI COST POST,GOVERNMENT	0.136	0.161	0.166	0.167	0.179	0.160	0.250
% EPI COST POST,PROPREITARY	0.133	0.167	0.171	0.175	0.158	0.155	0.700
% EPI COST POST,NON-PROFIT	0.122	0.126	0.135	0.145	0.155	0.167	0.022
TOTAL EPISODE REIMB,TEACHING	6286.607	7129.605	7862.646	6540.298	7771.675	6469.647	0.803
TOTAL EPISODE REIMB,GOVERNMENT	2960.249	3830.969	3652.785	3609.959	3800.067	3526.115	0.586
TOTAL EPISODE REIMB,PROPREITARY	4694.383	5580.955	5433.876	5271.722	5032.728	4412.463	0.428
TOTAL EPISODE REIMB,NON-PROFIT	4502.288	4691.578	4794.081	4815.477	4891.920	4477.158	0.691

Access to SNF or HHA services in 7 days appears unchanged for admissions to heavy teaching hospitals. But, increases are evident in the other three hospital types. Increases for proprietary institutions seem most pronounced. The fraction of episode payments for services rendered in the 30 days post discharge are much lower for teaching hospitals (where LOS is also largest) and the only trend evident is for non-profit hospitals.

Total episode payments by Medicare are generally consistent with the DRI inflation index. For strokes, proprietary and nonprofits continue to cost Medicare about two-thirds of what Medicare pays for admissions to major medical centers. Episodes involving admissions to government hospitals cost Medicare about 55% of major medical center amount.

4.0 HIP REPAIR EPISODES

Hip repair episodes were divided into two groups: DRG 209 with a diagnosis of osteoarthrosis, and DRG 209 with a diagnosis of hip fracture. The discussion follows the order of the seven groups of measures noted earlier:

- Features of Admitted Cases
- Use of Hospital Services
- Part B Service Use
- Post Hospital SNF and HHA Services
- Medicare Expenditures for the Episode
- Geographic Use Patterns
- Interhospital Differences

Features of Admitted Cases. There are clear differences between the two types of cases, but little indication of trend in any feature of the admitted cases we study. Table 4.1 displays these data. Hip fracture cases are, on average, about eight years older than the hip replacement cases with osteoarthrosis. The hip fractures are over 80 percent female and have higher pre-stay utilization rates for SNF and HHAs. Only one trend is statistically significant; beneficiary age for the hip fractures has increased about one half of a year over the six-year series.

The data does indicate that separation of osteoarthrosis from fractures within DRG 209 may be useful for analytic purposes. These data also suggest that there have not been marked trends in features of admitted cases, which might call into question the premise that the cases being studied are more or less similar over the six-year period.

Use of hospital services. Table 4.2 below includes a number of measures of hospital utilization for both groups of hip repair surgery.

Length of stay is about a day and a half longer for the fracture cases throughout the period. There are significant reductions in length of stay for both categories of patients, with length of stay being down by four to five days for both. About one day of this reduction is due to cuts in the number of pre surgical days for both tracers.

There are other changes in the intensity of care for hip surgery patients. For both tracers, the ratio of ancillary to total charges has increased significantly. On the other hand, the fraction of patients getting ICCU care has remained fairly constant over the period.

Table 4.1

FEATURES OF ADMITTED CASES: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	72.610	72.336	72.930	72.644	72.765	72.869	0.507
% FEMALE	0.595	0.619	0.601	0.610	0.601	0.606	0.919
% NON-WHITE	0.041	0.058	0.073	0.073	0.066	0.074	0.217
BENEFICIARY MEDICARE STATUS CODE=AGED	0.950	0.943	0.957	0.943	0.956	0.951	0.988
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.000	0.000	0.000	0.002	0.000	0.001	0.149
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.006	0.017	0.007	0.012	0.011	0.015	0.546
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	67.574	60.226	74.603	62.630	66.168	70.863	0.858
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.041	0.049	0.034	0.042	0.039	0.035	0.577
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	94.797	92.579	100.108	97.638	103.432	109.085	0.131

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	80.180	80.407	80.105	80.681	80.673	80.752	0.007
% FEMALE	0.831	0.804	0.830	0.807	0.807	0.800	0.142
% NON-WHITE	0.059	0.067	0.075	0.067	0.068	0.067	0.935
BENEFICIARY MEDICARE STATUS CODE=AGED	0.980	0.988	0.981	0.978	0.982	0.979	0.312
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.002	0.002	0.002	0.001	0.003	0.005	0.342
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.025	0.027	0.041	0.039	0.043	0.038	0.161
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	70.141	61.497	43.472	62.605	65.295	59.518	0.636
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.034	0.054	0.060	0.049	0.043	0.051	0.867
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	128.509	115.407	100.658	121.775	133.108	125.070	0.248

Table 4.2

USE OF HOSPITAL SERVICES: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	16.576	16.096	15.211	13.699	12.754	11.995	0.008
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.000	0.004	0.005	0.006	0.004	0.004	0.490
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.001	0.005	0.007	0.079
INT & COR CARE UNIT DAYS > 0	0.112	0.136	0.119	0.109	0.126	0.103	0.371
TOT ANCIL CHARGES / TOTAL CHARGES	0.658	0.667	0.689	0.715	0.731	0.751	0.011
# OF PRE SURGERY DAYS	2.119	1.970	1.994	1.568	1.375	1.182	0.006
# READMISSIONS W/IN 7 DAY POST PERIOD	0.019	0.025	0.017	0.015	0.030	0.028	0.483
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.000	0.009	0.007	0.012	0.010	0.011	0.108

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	18.117	17.539	16.870	14.880	13.847	13.324	0.004
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.025	0.020	0.019	0.016	0.014	0.017	0.044
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.007	0.009	0.019	0.033
INT & COR CARE UNIT DAYS > 0	0.162	0.176	0.193	0.180	0.172	0.180	0.993
TOT ANCIL CHARGES / TOTAL CHARGES	0.588	0.604	0.615	0.641	0.657	0.678	0.013
# OF PRE SURGERY DAYS	2.348	2.199	2.044	1.789	1.694	1.495	0.012
# READMISSIONS W/IN 7 DAY POST PERIOD	0.022	0.033	0.027	0.039	0.038	0.046	0.030
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.031	0.031	0.024	0.022	0.020	0.025	0.094

The use of subsequent hospitalizations has changed, but only for the fracture cases. Rates of external transfers, readmissions, and rehospitalizations are all higher for the fracture cases. For the osteoarthrosis cases there has been no significant change in the rate of external transfers, readmissions, or rehospitalizations; although there does appear to be a noticeable increase in rehospitalizations which was nearly significant. For fractures, rates of use of other hospitals seems lower; the external transfer rate is lower, and the rehospitalization rate is also lower. On the other hand, readmission rates (to the same hospital) within seven days are up significantly over the six-year period for fractures.

Use of Part B Services. Table 4.3 includes measures of the intensity of use of Part B services during episodes of hip surgery. The level of physician reimbursement is much higher for the osteoarthrosis patients than for the fractures. In both groups, the payments to physicians are decreasing relative to medical-care inflation for services provided in an in-patient setting; and, payments to both for services provided in the ambulatory setting is up. In view of the fee freeze, this probably indicates that the visit volumes in the office setting are higher, reflecting some substitution.

The level of outpatient department use over the window of time from 30 days before to 30 days after the focal stay have remained constant. But, the procedural intensity of the outpatient department visits has increased for both patient groups; the fraction of outpatient bills with surgery has been increasing. Emergency Room use has changed for both groups, but in opposite directions. Emergency Room use is much higher for the hip fracture cases, as would be expected. For the osteoarthrosis cases, the use of the Emergency Room has been reduced.

The use of DME products by both groups of patients over the pre 30-day to post 30-day period has increased significantly.[1]

Use of Post-Hospital Care SNF and HHA Services. Table 4.4 displays measures of Home Health and Nursing Home use for both groups of patients. Access to and utilization rates of post-hospital care services are markedly higher for both patient groups. In the seven days following discharge, over a third of the osteoarthrosis patients receive either SNF or HHA services, up from about 16 percent. For fractures, the increase has been from 39 percent to 53 percent.

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[1] A DME categorization is not included in the tracer files; however, DME for hip repair typically includes walking aids and wheelchairs.

Table 4.3

PART B SERVICES: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	1937.260	1936.453	1879.916	1752.409	1711.182	1511.725	0.028
MD OFFICE REIMB-(30-30)	48.174	60.811	66.324	61.972	68.851	73.320	0.202
RATIO OF MD REIMB. TO INPAT (30-30)	0.484	0.456	0.462	0.363	0.330	0.347	0.001
% WITH DME (30-30)	0.225	0.220	0.225	0.282	0.329	0.327	0.005
OPD CLINIC VISITS (30-30)	0.100	0.041	0.065	0.059	0.071	0.036	0.531
ER CLINIC VISITS (30-30)	0.084	0.077	0.086	0.059	0.068	0.066	0.010
% WITH OPD BILLS W/SURG (30-30)	0.004	0.007	0.012	0.016	0.026	0.028	0.025

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	1391.891	1358.649	1321.549	1270.281	1206.930	1139.166	0.024
MD OFFICE REIMB-(30-30)	46.403	57.669	41.927	61.879	66.712	61.915	0.040
RATIO OF MD REIMB. TO INPAT (30-30)	0.344	0.346	0.370	0.275	0.246	0.242	0.002
% WITH DME (30-30)	0.273	0.301	0.299	0.320	0.349	0.350	0.021
OPD CLINIC VISITS (30-30)	0.103	0.067	0.053	0.052	0.064	0.032	0.223
ER CLINIC VISITS (30-30)	0.153	0.132	0.149	0.165	0.180	0.210	0.052
% WITH OPD BILLS W/SURG (30-30)	0.003	0.006	0.007	0.019	0.019	0.035	0.025

Description of Selected Variables:

MD Inpatient Service Reimb. (30-30) = Part B Inpatient Reimb. Amt. Pre 30 to Post 30

MD Office Reimb. (30-30) = Part B Physician Reimb. Amt. Pre 30 day and Post 30 day periods.

Ratio of MD Reimb. to Inpat. (30-30) = (MD Inpat. Service Reimb. + MD Office Reimb.)/Hospital Inpat. Stay Reimb.

Table 4.4

POST HOSPITAL SERVICES: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.048	0.072	0.054	0.070	0.085	0.097	0.072
# COVERED SNF DAYS IN POST 30 PERIOD	0.671	1.135	0.979	1.128	1.349	1.232	0.110
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.109	0.154	0.189	0.221	0.259	0.272	0.022
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.118	0.174	0.210	0.240	0.275	0.293	0.030
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.132	0.191	0.228	0.263	0.308	0.327	0.027
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.145	0.201	0.245	0.275	0.324	0.340	0.030
TOTAL # HHA VISITS IN POST 7 PERIOD	0.297	0.428	0.571	0.789	0.938	0.950	0.008
TOTAL # HHA VISITS IN POST 14 PERIOD	0.596	0.875	1.163	1.575	1.804	1.888	0.010
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.251	0.354	0.293	0.327	0.291	0.283	0.976
# HHA THERAPY VISITS IN POST 14 PERIOD	0.101	0.122	0.168	0.184	0.227	0.239	0.029
POST HOSP CARE RATE IN POST 7 PERIOD	0.157	0.225	0.242	0.286	0.336	0.361	0.025

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.259	0.270	0.270	0.301	0.329	0.330	0.006
# COVERED SNF DAYS IN POST 30 PERIOD	5.664	5.929	6.059	6.241	6.352	6.194	0.039
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.130	0.179	0.198	0.192	0.207	0.209	0.182
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.162	0.199	0.218	0.210	0.242	0.239	0.123
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.197	0.231	0.257	0.256	0.297	0.302	0.068
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.227	0.260	0.294	0.303	0.340	0.347	0.043
TOTAL # HHA VISITS IN POST 7 PERIOD	0.423	0.572	0.654	0.678	0.795	0.821	0.056
TOTAL # HHA VISITS IN POST 14 PERIOD	0.895	1.197	1.357	1.364	1.639	1.638	0.072
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.422	0.365	0.365	0.330	0.322	0.298	0.035
# HHA THERAPY VISITS IN POST 14 PERIOD	0.130	0.151	0.164	0.170	0.192	0.196	0.042
POST HOSP CARE RATE IN POST 7 PERIOD	0.387	0.441	0.464	0.485	0.525	0.530	0.038

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Use of SNF services is much higher for the fracture patients, and this and the SNF admission rate and days of care have both increased. SNF admission rates for osteoarthrosis patients have also increased, as have average days of care within the post-30-day period. The use of Home Health Services is also up for both groups. The fractions of patients using Home Health are comparable for both types of patients. The increase in the fraction of patients using Home Health within 7, 14, 30, and 60 days post-discharge have increased more for osteoarthrosis, more than doubling over the six-year period.

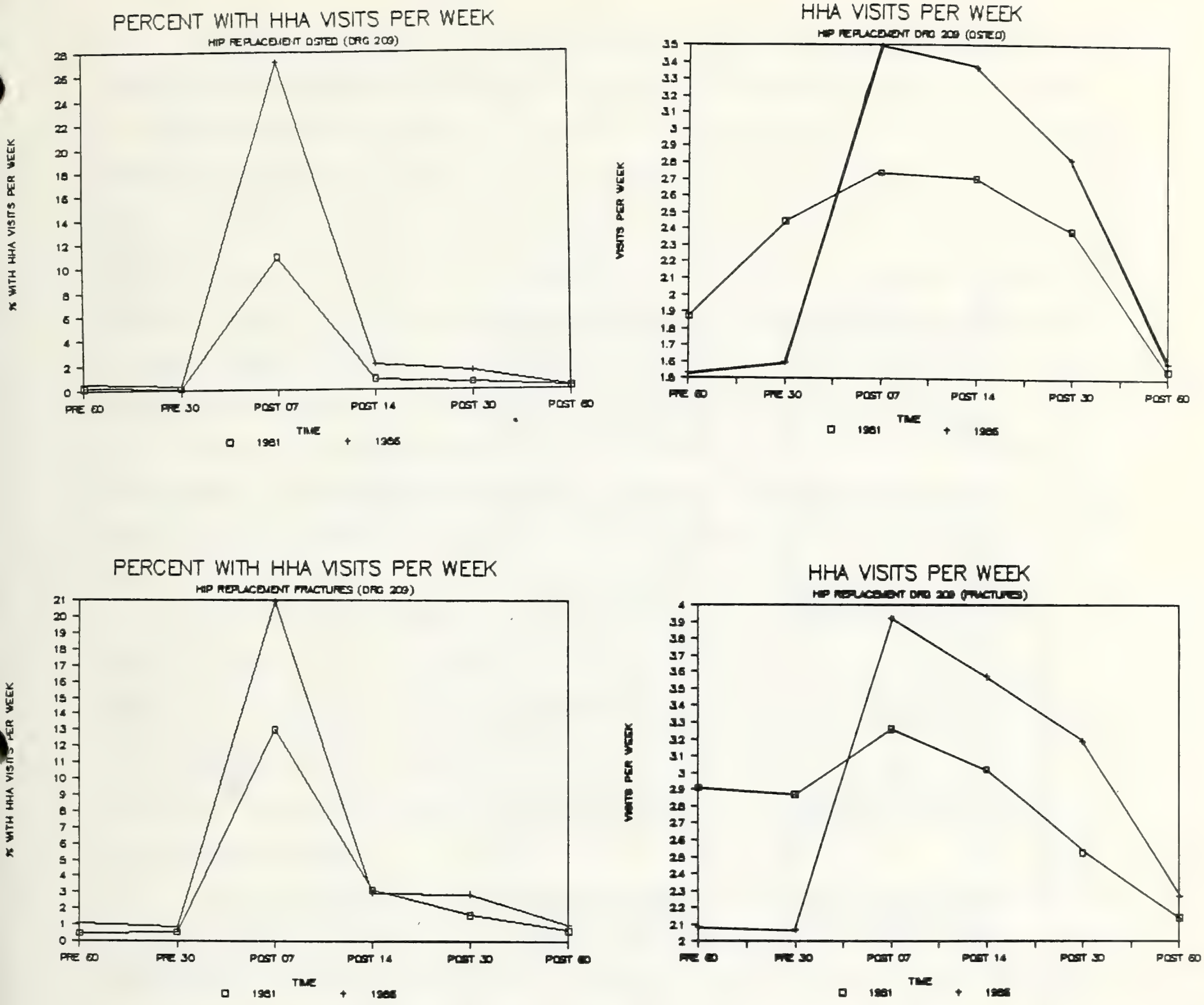
The content of Home Health agency service use is changing. For osteoarthrosis we see an increase in the intensity of therapist utilization and a fairly proportional increase in skilled nursing services relative to the overall increase in service volumes. For fractures, we also see an increase in the number of therapy visits delivered within the 14-day post period and a fall in the fraction of visits delivered by RNs over that post-30-day period.

The accompanying figure (4.1) describes home health use post discharge in more detail. The left panel shows the likelihood of a beneficiary initiating HHA care in any week in 1981 and 1986. These charts are to be interpreted as hazard rates; how does the intervention of a hospital stay alter the likelihood of HHA use? These figures show that for both tracers, post (1986) period access is different in only one way; the likelihood of using HHA care is higher in the first week post discharge. For other points in time there basically is no change in HHA access rates (though the background access rate is possible slightly higher in 1986).

The right side of the chart shows intensity of HHA visits per week, for persons using at least 1 visit. The basic finding is that intensity is up in all cases in the first week post discharge and thereafter for both conditions. Interestingly, the use rates of HHA care in the pre-stay period are lower in 1986. One plausible explanation is that surgery is being done more quickly in the degenerative process of osteoarthrosis, eliminating the need for large volumes of service for persons approaching the point where surgery is essential.

Expenditures for the Episode. Table 4.5 summarizes Medicare reimbursements for the period spanning 30 days pre admission to 30 days post discharge. Total episode payments are slightly higher for the osteoarthrosis patients, compared to fractures, and have remained roughly constant at about $7,500 over the period. Episode costs for hip fractures have increased slightly in real terms. The hospital payment portions of these episode costs have each increased relative to the medical care price index over the six years.

Figure 4.1



HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED PER CAPITA ANALYSIS

Table 4.5

EXPENDITURES & INTENSITY OF EPISODE USE: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	7372.273	7546.755	7233.571	7698.361	7975.127	7347.915	0.227
% EPI REIMB PRE	0.013	0.012	0.013	0.012	0.013	0.014	0.456
% EPI REIMB POST	0.032	0.042	0.041	0.046	0.054	0.059	0.034
% EPI REIMB POST (EX REHOSP & READM)	0.019	0.025	0.027	0.030	0.033	0.035	0.030
% EPI INPATIENT	0.955	0.946	0.946	0.941	0.933	0.927	0.040
% EPI INPATIENT (INC REHOSP & READM)	0.968	0.963	0.959	0.957	0.953	0.950	0.039
% EPI MD	0.281	0.280	0.283	0.239	0.221	0.214	0.002
% EPI PART B	0.290	0.289	0.291	0.248	0.231	0.224	0.002
% EPI HHA	0.005	0.008	0.010	0.013	0.014	0.016	0.017
% EPI SNF	0.005	0.008	0.007	0.008	0.009	0.010	0.100
AMOUNT REIMBURSED	5072.054	5082.064	4863.164	5411.687	5634.028	5188.780	0.051

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	7058.008	7084.719	6923.578	7569.964	7740.627	7305.832	0.019
% EPI REIMB PRE	0.018	0.017	0.016	0.016	0.017	0.017	0.856
% EPI REIMB POST	0.089	0.102	0.103	0.102	0.106	0.113	0.176
% EPI REIMB POST (EX REHOSP & READM)	0.066	0.068	0.072	0.068	0.072	0.076	0.336
% EPI INPATIENT	0.893	0.882	0.881	0.882	0.877	0.870	0.158
% EPI INPATIENT (INC REHOSP & READM)	0.915	0.915	0.913	0.916	0.911	0.908	0.351
% EPI MD	0.215	0.213	0.210	0.179	0.163	0.161	0.002
% EPI PART B	0.230	0.228	0.227	0.194	0.178	0.177	0.001
% EPI HHA	0.010	0.013	0.015	0.015	0.017	0.017	0.094
% EPI SNF	0.041	0.039	0.041	0.037	0.038	0.041	0.276
AMOUNT REIMBURSED	4779.623	4761.982	4664.379	5257.271	5422.564	5059.978	0.010

The portion of the episode costs incurred in the 30 days prior to admission have remained fairly constant for both types of cases at a level between one and two percent of total episode reimbursements. The portion of the episode costs incurred in the post-30-day period has gone from three to six percent for osteoarthrosis and has gone from nine to eleven percent for the hip fractures. Two definitions of post hospital care are shown. The first shows all reimbursements in the 30 days post discharge, including subsequent hospital stays. On this measure, there has been an increase for both hip subtracers; however, only the osteo tracer is statistically significant. The measure that excludes inpatient care also shows an increase in both hip subtracers with the increase in the fracture subtracer not being statistically significant.

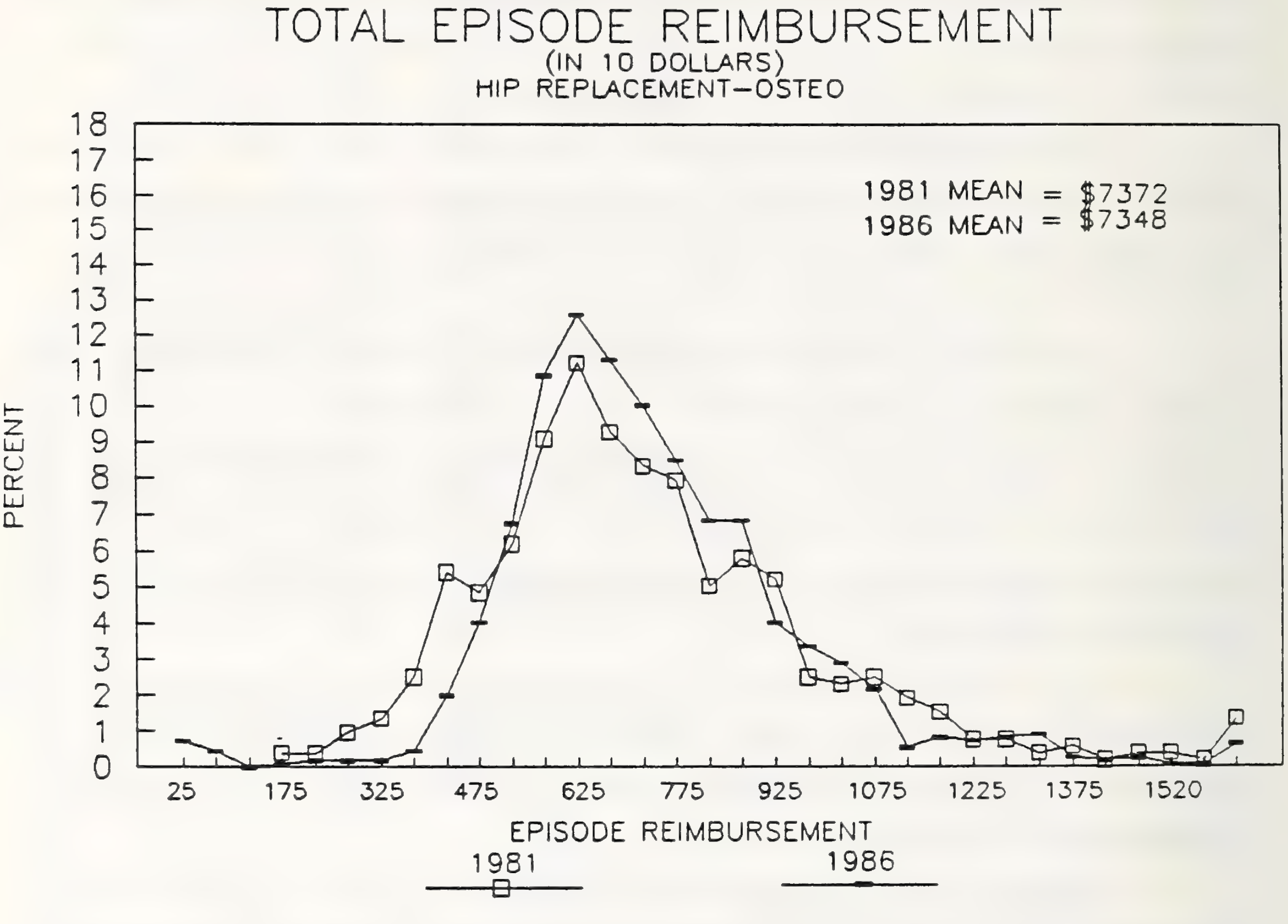
Part B reimbursements have fallen in real terms for both kinds of cases. This change tracks the downward trend in real reimbursements for physician services, which have fallen from about 29 percent of total episode cost to 22 percent for the osteoarthrosis cases, and fallen from about 21 percent to 16 percent for hip fractures.

The fraction of episode costs for Home Health services is now higher for both types of cases, but still less than two percent of total episode reimbursements. For skilled nursing facilities the fraction of episode costs is higher for osteoarthrosis, but payments for SNF services are still less than reimbursements for Home Health Care for these patients. On the other hand, SNF payments are much larger than those for Home Health for hip fractures (about four percent of episode costs), but have remained flat over the six-year period.

Figure 4.2 shows the distributions of episode spending for hip replacement for 1981 and 1986. The figure suggests that there has been no observable change in the distribution of reimbursements across episodes. There may be a slight tendency in compression in the distribution in 1986.

Geographic Use Patterns. Table 4.6 describes the locational structure of admissions for hip surgery patients and utilization rates for beneficiaries residing in different places. The distinction between the elective osteoarthrosis procedure and the urgent procedure for hip fractures is evident in these data. Osteoarthrosis hip procedures are rarely done in rural hospitals relative to the importance of rural hospitals in admitting hip fracture patients. These patterns have changed somewhat; there are suggestions in both groups that admissions to rural hospitals are more frequent and reliance on urban hospitals by rural beneficiaries is less obvious over the six-year period. These changes can also be seen in the external transfer rates. We note for fractures, transfers from rural hospitals are down from about seven and a half percent in 1981 to

Figure 4.2


TOTAL EPISODE REIMBURSEMENT
(IN 10 DOLLARS)
HIP REPLACEMENT–OSTEO
1981 MEAN = $7372
1986 MEAN = $7348
PERCENT
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
25
175
325
475
625
775
925
1075
1225
1375
1520
EPISODE REIMBURSEMENT
1981
1986

about one percent in 1986. Interestingly, beneficiaries residing in urban areas are experiencing higher transfer rates for both osteoarthrosis and hip fractures.

Days of care, including the focal admission and any subsequent admission during the episode, are higher for hip fractures and significantly down over the period for both kinds of cases. There has been a larger decrease in days of care for rural hospital admissions than for urban ones, resulting in fewer days of care per episode in rural hospitals at the end of the period, although days of care had been larger in rural areas at the beginning. This phenomenon for fractures may be, in part, the result of higher transfer rates we observe in urban hospitals and, together, may partially explain why hospital payments per episode for fractures increased significantly over the six-year period.

Physician payments are generally higher in urban areas and higher for osteoarthrosis patients. Trends for both show significant reductions against the DRI inflation index. The urban-rural differences in physician payments are much larger for hip fractures than for osteoarthrosis patients.

Table 4.6 shows that the access to post-hospital care SNF and HHA services is getting better in both urban and rural areas. For osteoarthrosis, note that the access to SNF or HHA services within seven days is lower for persons who are residents of rural areas and were discharged from urban hospitals. While this rate of access has improved, the fact that it is still markedly lower than for persons living more proximate to their hospital represents a potentially important access problem for the program and continues to be a reflection of difficulties in the discharge-planning process. For hip fractures, we observe very high rates of post-hospital care use for urban beneficiaries going to urban hospitals, but this rate is not increasing significantly over time. On the other hand, rural beneficiaries going to rural hospitals, and rural beneficiaries going to urban hospitals have both experienced large improvements in access, essentially closing the access gap with their urban counterparts.

Interhospital Differences and Episode Use. The data in Table 4.7 have been prepared only for the fracture patients, the larger of the two hip-repair categories. Length of stay has been reduced, although the change was not statistically significant for the major medical center group. Interestingly, the disparities in lengths of stay across hospital types are not nearly as pronounced for these hip fracture cases as is true of the other tracer we study.

There have been increases in all categories of hospitals in the rate at which patients access some form of SNF or HHA service within seven days. However, these increases are not statistically significant for proprietary and teaching hospitals.

Table 4.6

GEOGRAPHIC USE PATTERNS: HIPS

DRG 209 (OSTEO DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.548	0.594	0.588	0.570	0.585	0.567	0.859
% RURAL RESIDENCE	0.399	0.386	0.401	0.401	0.375	0.395	0.613
% IN RURAL HOSPITALS	0.151	0.162	0.184	0.190	0.177	0.187	0.139
% RURAL BENEF IN URBAN HOSPITALS	0.641	0.590	0.552	0.548	0.551	0.542	0.142
RURAL EXT TRANSFERS(HOSP)	0.000	0.000	0.011	0.009	0.000	0.005	0.850
RURAL BENE EXT TRANS	0.000	0.011	0.008	0.006	0.000	0.002	0.419
URBAN BENE EXT TRANS	0.000	0.000	0.003	0.006	0.006	0.005	0.024
RURAL DAYS OF CARE	16.495	15.508	15.247	13.523	12.319	11.924	0.007
URBAN DAYS OF CARE	16.625	16.558	15.297	13.897	13.134	12.222	0.009
RURAL MD REIMB	1760.267	1765.590	1675.023	1653.536	1574.669	1444.244	0.060
URBAN MD REIMB	2048.505	2039.655	2017.162	1817.984	1793.919	1560.848	0.020
RURAL 7 DAY PHC RATE	0.122	0.174	0.174	0.241	0.344	0.369	0.020
URBAN 7 DAY PHC RATE	0.185	0.262	0.295	0.335	0.375	0.396	0.031
RURAL/URBAN 7 DAY PHC RATE	0.115	0.161	0.159	0.197	0.220	0.261	0.029

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.756	0.728	0.715	0.722	0.721	0.725	0.449
% RURAL RESIDENCE	0.264	0.309	0.332	0.332	0.323	0.358	0.183
% IN RURAL HOSPITALS	0.188	0.225	0.231	0.250	0.242	0.250	0.073
% RURAL BENEF IN URBAN HOSPITALS	0.355	0.331	0.365	0.316	0.306	0.354	0.232
RURAL EXT TRANSFERS(HOSP)	0.075	0.036	0.027	0.015	0.010	0.011	0.082
RURAL BENE EXT TRANS	0.065	0.046	0.038	0.014	0.018	0.011	0.014
URBAN BENE EXT TRANS	0.011	0.009	0.010	0.016	0.013	0.022	0.058
RURAL DAYS OF CARE	19.243	17.056	17.017	14.934	13.214	12.885	0.014
URBAN DAYS OF CARE	18.053	18.247	17.348	15.229	14.396	14.066	0.002
RURAL MD REIMB	1181.817	1146.846	1109.928	1048.738	994.955	919.378	0.021
URBAN MD REIMB	1467.268	1454.590	1431.297	1385.262	1313.282	1270.461	0.022
RURAL 7 DAY PHC RATE	0.220	0.230	0.362	0.363	0.433	0.468	0.052
URBAN 7 DAY PHC RATE	0.433	0.536	0.532	0.553	0.560	0.562	0.164
RURAL/URBAN 7 DAY PHC RATE	0.352	0.282	0.311	0.366	0.506	0.498	0.046

Table 4.7

INTER HOSPITAL DIFFERENCES IN EPISODE HIPS

DRG 209 (FRACTURE DX)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LOS FOR HEAVY TEACHING	15.545	22.324	16.182	16.093	14.016	14.510	0.235
LOS FOR GOVERNMENT	17.856	15.791	16.811	14.069	12.792	12.498	0.008
LOS FOR PROPREITARY	16.197	17.024	17.474	13.739	13.781	12.903	0.002
LOS FOR NON-PROFIT	18.602	17.848	16.826	15.220	14.093	13.707	0.008
SOME PHC IN 7 DAYS,TEACHING	0.227	0.441	0.394	0.512	0.438	0.490	0.141
SOME PHC IN 7 DAYS,GOVERNMENT	0.299	0.343	0.398	0.437	0.550	0.522	0.025
SOME PHC IN 7 DAYS,PROPREITARY	0.451	0.528	0.569	0.560	0.551	0.552	0.334
SOME PHC IN 7 DAYS,NON-PROFIT	0.404	0.451	0.470	0.484	0.519	0.524	0.044
RATIO OF MD REIMB TO INPAT,TEACHING	0.236	0.215	0.217	0.169	0.148	0.136	0.004
RATIO OF MD REIMB TO INPAT,GOVERNMENT	0.358	0.391	0.363	0.296	0.253	0.254	0.004
RATIO OF MD REIMB TO INPAT,PROPREITARY	0.380	0.406	0.539	0.309	0.332	0.260	0.058
RATIO OF MD REIMB TO INPAT,NON-PROFIT	0.341	0.330	0.354	0.267	0.233	0.235	0.002
% WITH EXTERNAL TRANSFERS,TEACHING	0.000	0.029	0.061	0.023	0.016	0.039	0.843
% WITH EXTERNAL TRANSFERS,GOVERNMENT	0.052	0.029	0.015	0.015	0.009	0.020	0.197
% WITH EXTERNAL TRANSFERS,PROPREITARY	0.000	0.032	0.029	0.024	0.031	0.017	0.754
% WITH EXTERNAL TRANSFERS,NON-PROFIT	0.024	0.015	0.018	0.014	0.013	0.016	0.166
% EPI COST POST,TEACHING	0.064	0.068	0.107	0.088	0.080	0.095	0.618
% EPI COST POST,GOVERNMENT	0.079	0.114	0.092	0.100	0.106	0.120	0.316
% EPI COST POST,PROPREITARY	0.104	0.122	0.132	0.106	0.112	0.118	0.441
% EPI COST POST,NON-PROFIT	0.090	0.096	0.102	0.102	0.106	0.110	0.075
TOTAL EPISODE REIMB,TEACHING	8231.091	10676.5	8208.435	9507.063	9822.900	10227.9	0.390
TOTAL EPISODE REIMB,GOVERNMENT	6148.598	5480.315	5924.555	6529.429	6395.793	6230.527	0.068
TOTAL EPISODE REIMB,PROPREITARY	7753.352	8435.719	8589.906	7839.493	8385.438	7580.376	0.406
TOTAL EPISODE REIMB,NON-PROFIT	7086.976	7061.829	6916.695	7725.012	7835.137	7350.485	0.017

Transfer rates appear not to have changed significantly for any group of hospitals. We also note that there has been little change in the fraction of the post-period reimbursements as a fraction of total episode reimbursements, with the exception of non-profit hospitals, where the trend seems to be in an upward direction.

Total episode reimbursement is, not surprisingly, much higher for admissions to major medical centers than for the other types of hospitals. Total episode reimbursements have increased against the medical care inflation index for both government and non-profit hospitals, which tends to close the gap in episode outlays across the four hospital types.

5.0 PNEUMONIA EPISODES

Pneumonia episodes were divided into two groups; DRGs 79, 80, including infections and inflammation of the lung; and DRGs 89, 90, representing simple pneumonia. The discussion follows the order of the seven groups of measures noted earlier:

- Features of admitted cases
- Use of hospital service
- Part B service use
- Post-hospital SNF and HHA services
- Medicare expenditures for the episode
- Geographic use patterns
- Interhospital differences

Features of Admitted Cases. As indicated in Table 5.1, there are not large differences in the two groups of cases. Average age is about the same at 77 years, although there is a significant trend in the simple pneumonias getting slightly older over the six-year period. There is also a trend upward in the fraction of the infection cases who are not white, up from about nine percent to almost 14 percent.

Pre-period use is different for the two groups, and has changed significantly. Pre-period Home Health Care use is up for both groups. The fraction using SNF services has not increased for either group, but is noticeably larger in magnitude for the lung infection cases. The fraction of persons who were admitted to hospitals between the 30- and 60-day pre-period has not changed for either group. Total Medicare reimbursements and physician payments in the pre-period are both higher.

Use of Hospital Services. Table 5.2 describes measures of hospital use for both groups of patients over the six-year period. There have been significant reductions in the intensity of hospital use for both groups of patients. Length of stay, which is much longer for the lung infection patients, is significantly down for both types of patients. The ratio of ancillary to total charges is up significantly for both groups. And, the fraction of persons having access to ICCU services is up for both groups, although statistically insignificant for the simple pneumonias.

There have been virtually no changes in the frequencies of subsequent stays for both groups of patients. The transfer rate to other hospitals has not changed for either

HOSPITAL ADMISSIONS
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Table 5.1

FEATURES OF ADMITTED CASES: PNEUMONIA

DRG 79,80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	77.145	75.800	77.160	77.223	77.459	76.861	0.377
% FEMALE	0.461	0.453	0.440	0.472	0.454	0.482	0.153
% NON-WHITE	0.092	0.107	0.080	0.119	0.121	0.139	0.029
BENEFICIARY MEDICARE STATUS CODE=AGED	0.947	0.933	0.888	0.944	0.915	0.922	0.847
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.013	0.013	0.032	0.025	0.010	0.023	0.983
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.039	0.013	0.072	0.082	0.085	0.096	0.058
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	32.934	72.943	28.055	74.371	76.589	78.190	0.090
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.158	0.093	0.112	0.136	0.163	0.121	0.458
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	83.776	150.523	122.214	195.735	204.142	199.659	0.014

DRG 89,90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	76.387	76.249	76.313	76.609	77.062	77.163	0.023
% FEMALE	0.506	0.509	0.523	0.509	0.524	0.520	0.474
% NON-WHITE	0.099	0.108	0.105	0.106	0.116	0.116	0.102
BENEFICIARY MEDICARE STATUS CODE=AGED	0.924	0.912	0.919	0.919	0.926	0.929	0.243
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.006	0.006	0.007	0.006	0.008	0.006	0.544
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.036	0.040	0.044	0.060	0.057	0.051	0.011
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	44.657	38.353	42.347	43.527	48.579	49.453	0.107
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.091	0.089	0.090	0.103	0.092	0.094	0.137
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	91.117	84.437	94.004	104.515	122.523	116.861	0.015

Table 5.2

USE OF HOSPITAL SERVICES: PNEUMONIA

DRG 79.80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	14.303	13.267	14.496	12.198	11.937	11.386	0.008
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.013	0.027	0.016	0.011	0.010	0.018	0.321
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.000	0.002	0.002	0.116
INT & COR CARE UNIT DAYS > 0	0.184	0.133	0.152	0.223	0.248	0.244	0.008
TOT ANCIL CHARGES / TOTAL CHARGES	0.594	0.628	0.642	0.639	0.662	0.664	0.108
# READMISSIONS W/IN 7 DAY POST PERIOD	0.026	0.040	0.056	0.042	0.046	0.030	0.896
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.013	0.040	0.016	0.023	0.022	0.025	0.988

DRG 89.90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	9.905	10.307	9.873	8.550	8.111	8.276	0.001
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.013	0.015	0.015	0.013	0.013	0.013	0.153
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.000	0.001	0.001	0.042
INT & COR CARE UNIT DAYS > 0	0.104	0.106	0.112	0.110	0.109	0.127	0.251
TOT ANCIL CHARGES / TOTAL CHARGES	0.545	0.557	0.572	0.591	0.614	0.627	0.016
# READMISSIONS W/IN 7 DAY POST PERIOD	0.039	0.040	0.035	0.040	0.036	0.042	0.667
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.019	0.021	0.020	0.021	0.020	0.019	0.989

group, nor has the readmission rate or rehospitalization rate within the post-seven-day period.

Use of Part B Services. Levels of Part B charges are higher for the infection patients than for the simple pneumonia patients. For both groups Table 5.3 shows that the level of physician in-patient reimbursements has fallen and the level of physician ambulatory reimbursements has increased. In fact, the level of physician reimbursement has dropped much more dramatically for simple pneumonia than for the infection cases, where in-patient reimbursements to physicians have not fallen against the medical care price index. Clearly a shift in the importance of the out-patient setting has occurred inasmuch as payments are increasing faster than the medical care price index in spite of the fee freeze.

The use of durable medical equipment has risen significantly for both patient groups. In the case of infections, the increase has been much more substantial, where the fraction of patients receiving DME[1] services during the episode has more than doubled, up from about 13 percent to about 27 percent.

The frequency of use of out-patient departments and emergency rooms has not increased for either group of patients. We do see, however, that the fraction of out-patient department bills having a procedure code has increased for both types of patients over the six-year period, reflecting a change in the procedural intensity of out-patient department services.

Post-hospital Care Services in SNF and HHAs. Table 5.4 indicates that access to post-hospital care SNF or HHA services within seven days has increased significantly for both patient groups. The fraction of persons getting one or the other of these services within seven days is up by 70 percent for infections and about 100 percent for simple pneumonias. The rate at which persons access such services within seven days is about double for the infections relative to simple pneumonias.

Use of SNF services is up marginally in both patient groups. The only significant increase is the rise in the number of SNF days in the post-30-day period for infection patients. For HHAs, on the other hand, all measures are up significantly. We see that use levels of Home Health Services are about 50 percent higher for infections than for simple pneumonias. And the fraction of persons getting Home Health Services within seven days is more than doubled for both patient groups.

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[1] A DME categorization is not included in the tracer files; however, DME for pneumonia typically includes oxygen, ventilators, nebulizers and humidifiers.

Table 5.3

PART B SERVICES: PNEUMONIA

DRG 79,80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	485.079	432.913	461.170	439.514	484.782	367.757	0.479
MD OFFICE REIMB-(30-30)	28.934	34.022	30.910	50.578	48.588	54.324	0.001
RATIO OF MD REIMB. TO INPAT (30-30)	0.236	0.456	0.147	0.130	0.117	0.101	0.151
% WITH DME (30-30)	0.132	0.133	0.216	0.246	0.282	0.274	0.023
OPD CLINIC VISITS (30-30)	0.039	0.093	0.040	0.046	0.047	0.046	0.563
ER CLINIC VISITS (30-30)	0.114	0.160	0.096	0.141	0.165	0.213	0.158
% WITH OPD BILLS W/SURG (30-30)	0.000	0.013	0.008	0.011	0.022	0.048	0.160

DRG 89,90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	329.380	329.499	315.960	280.010	259.944	253.980	0.003
MD OFFICE REIMB-(30-30)	29.028	26.442	30.227	34.160	42.742	43.627	0.023
RATIO OF MD REIMB. TO INPAT (30-30)	0.242	0.288	0.290	0.164	0.155	0.150	0.002
% WITH DME (30-30)	0.132	0.141	0.165	0.199	0.217	0.206	0.006
OPD CLINIC VISITS (30-30)	0.103	0.067	0.064	0.053	0.051	0.062	0.158
ER CLINIC VISITS (30-30)	0.142	0.107	0.111	0.122	0.159	0.162	0.177
% WITH OPD BILLS W/SURG (30-30)	0.004	0.005	0.007	0.018	0.029	0.033	0.010

Description of Selected Variables:

MD Inpatient Service Reimb. (30-30) = Part B Inpatient Reimb. Amt. Pre 30 to Post 30

MD Office Reimb. (30-30) = Part B Physician Reimb. Amt. Pre 30 day and Post 30 day periods.

Ratio of MD Reimb. to Inpat. (30-30) = (MD Inpat. Service Reimb. + MD Office Reimb.)/Hospital Inpat. Stay Reimb.

Table 5.4

POST HOSPITAL SERVICES: PNEUMONIA

DRG 79,80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.066	0.027	0.048	0.054	0.087	0.073	0.176
# COVERED SNF DAYS IN POST 30 PERIOD	0.750	0.200	0.872	1.054	1.308	1.279	0.052
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.066	0.093	0.088	0.119	0.126	0.153	0.020
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.092	0.093	0.088	0.124	0.133	0.155	0.008
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.092	0.093	0.088	0.136	0.138	0.174	0.009
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.105	0.107	0.104	0.138	0.143	0.189	0.034
TOTAL # HHA VISITS IN POST 7 PERIOD	0.276	0.280	0.158	0.349	0.447	0.464	0.028
TOTAL # HHA VISITS IN POST 14 PERIOD	0.720	0.552	0.322	0.630	0.843	0.840	0.151
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.640	0.694	0.754	0.776	0.689	0.747	0.379
# HHA THERAPY VISITS IN POST 14 PERIOD	0.039	0.013	0.008	0.011	0.015	0.016	0.555
POST HOSP CARE RATE IN POST 7 PERIOD	0.132	0.120	0.136	0.172	0.209	0.224	0.011

DRG 89,90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.023	0.024	0.027	0.025	0.034	0.034	0.107
# COVERED SNF DAYS IN POST 30 PERIOD	0.372	0.438	0.467	0.398	0.435	0.479	0.761
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.044	0.058	0.076	0.085	0.099	0.109	0.030
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.050	0.065	0.084	0.091	0.107	0.116	0.034
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.058	0.071	0.091	0.102	0.117	0.125	0.024
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.068	0.076	0.099	0.113	0.127	0.134	0.017
TOTAL # HHA VISITS IN POST 7 PERIOD	0.114	0.144	0.228	0.233	0.309	0.326	0.046
TOTAL # HHA VISITS IN POST 14 PERIOD	0.228	0.287	0.448	0.461	0.584	0.612	0.045
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.712	0.731	0.720	0.735	0.741	0.743	0.041
# HHA THERAPY VISITS IN POST 14 PERIOD	0.007	0.009	0.015	0.012	0.012	0.014	0.350
POST HOSP CARE RATE IN POST 7 PERIOD	0.067	0.082	0.103	0.110	0.131	0.142	0.037

The composition of Home Health Services has changed somewhat over the period. We do not see any change in the number of therapy visits that the average person is getting in the post-14-day period for either group. On the other hand, skilled nursing visits are increasing faster than all Home Health visits for simple pneumonias. This increase in intensity is not apparent for the infection cases.

The accompanying figure (5.1) describes home health use post discharge in more detail. The left panel shows the likelihood of a beneficiary initiating HHA care in any week in 1981 and 1986. These charts are to be interpreted as hazard rates; how does the intervention of a hospital stay alter the likelihood of HHA use? These figures show that for both tracers, post (1986) access is different in only one way; the likelihood of using HHA care is higher in the first week post discharge. For other points in time there basically is no change in HHA access rates (though the background access rate is possibly slightly higher in 1986).

The right side of the chart shows intensity of HHA visits per week, for persons using at least 1 visit. The basic finding is that intensity is up for simple pneumonia cases in all periods for DRGs 79/80, intensity is lower in 1986 through the first four weeks post discharge.

Expenditures over the Episode. Table 5.5 shows that episode reimbursements are more than 50 percent higher for infections than for simple pneumonia. Relative to the medical care price index, the episode reimbursements have grown significantly for the infection cases and remained relatively stable for the simple pneumonia cases. Like other tracers, the changes in episodes reimbursements for infection are not driven by changes in pre- and post-stay reimbursements, but are driven by changes in the amount of reimbursement for services rendered to the hospitalized patient. Payments to hospitals are up slightly for the infection cases and down slightly for the simple pneumonia cases.

Part B payments as a fraction of episodes are down for both patient groups; from about 15 percent of total episode cost to 10 or 11 percent. These changes are driven by physician reimbursements. The share of episode payments going to physicians has been cut by about 50 percent for both types of patients; down from about 14 percent to seven percent of total episode costs for the infection cases; and down from about twelve percent to about eight percent for the simple pneumonia cases. This is a fee freeze consequence. The first definition of post hospital care, which includes subsequent hospital stays, shows an increase for both pneumonia subtracers. (Only DRG 89, 90 is statistically significant, however). The measure that excludes rehospitalizations and readmissions shows a slight increase, which is not significant.

Figure 5.1

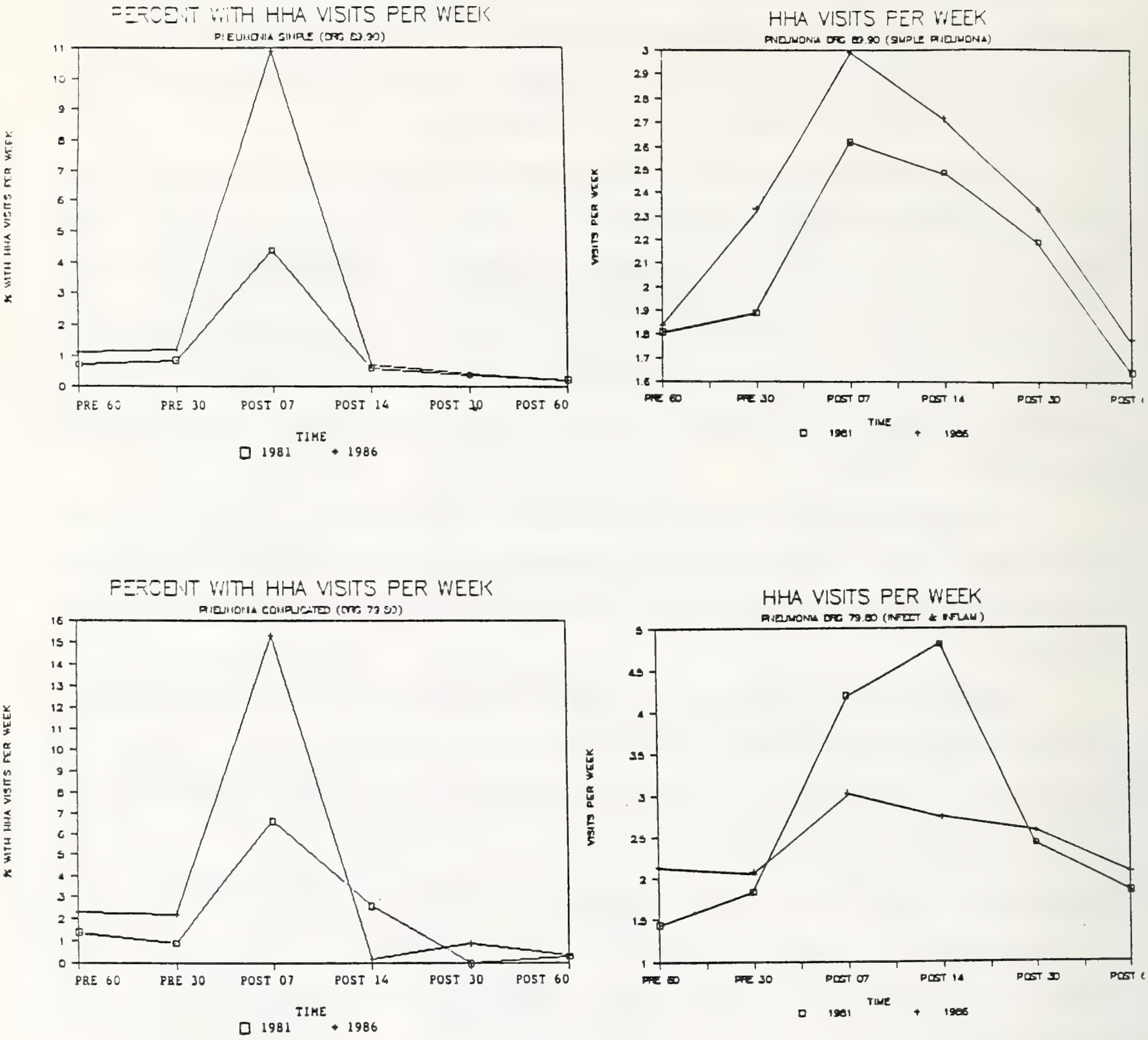

PERCENT WITH HHA VISITS PER WEEK
PNEUMONIA SIMPLE (DRG 89.90)
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
7
8
9
10
11
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
PNEUMONIA DRG 89.90 (SIMPLE PNEUMONIA)
VISITS PER WEEK
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST
TIME
□ 1981
+ 1986
PERCENT WITH HHA VISITS PER WEEK
PNEUMONIA COMPLICATED (DRG 79.80)
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
PNEUMONIA DRG 79.80 (INFECT & INFLAM)
VISITS PER WEEK
1
1.5
2
2.5
3
3.5
4
4.5
5
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST
TIME
□ 1981
+ 1986

Table 5.5

EXPENDITURES & INTENSITY OF EPISODE USE: PNEUMONIA

DRG 79.80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	4704.947	4343.686	5357.566	5507.390	5912.720	5339.707	0.083
% EPI REIMB PRE	0.026	0.052	0.034	0.034	0.032	0.035	0.662
% EPI REIMB POST	0.061	0.086	0.096	0.089	0.097	0.097	0.294
% EPI REIMB POST (EX REHOSP & READM)	0.027	0.038	0.027	0.033	0.039	0.041	0.168
% EPI INPATIENT	0.913	0.862	0.870	0.877	0.870	0.868	0.591
% EPI INPATIENT (INC REHOSP & READM)	0.947	0.910	0.939	0.933	0.929	0.924	0.767
% EPI MD	0.135	0.120	0.092	0.086	0.078	0.070	0.051
% EPI PART B	0.148	0.152	0.117	0.110	0.105	0.095	0.042
% EPI HHA	0.013	0.007	0.009	0.011	0.014	0.015	0.126
% EPI SNF	0.008	0.006	0.012	0.010	0.010	0.010	0.488
AMOUNT REIMBURSED	3823.408	3288.428	4081.684	4181.361	4448.193	4050.745	0.131

DRG 89.90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	3215.751	3350.134	3380.274	3264.871	3273.608	3087.327	0.248
% EPI REIMB PRE	0.036	0.034	0.036	0.032	0.034	0.035	0.211
% EPI REIMB POST	0.095	0.098	0.102	0.104	0.103	0.108	0.061
% EPI REIMB POST (EX REHOSP & READM)	0.036	0.036	0.040	0.039	0.042	0.046	0.117
% EPI INPATIENT	0.870	0.869	0.862	0.863	0.863	0.857	0.147
% EPI INPATIENT (INC REHOSP & READM)	0.928	0.931	0.924	0.929	0.924	0.920	0.347
% EPI MD	0.124	0.115	0.115	0.094	0.084	0.085	0.002
% EPI PART B	0.149	0.141	0.143	0.121	0.113	0.115	0.002
% EPI HHA	0.007	0.009	0.011	0.012	0.014	0.014	0.026
% EPI SNF	0.005	0.005	0.004	0.005	0.006	0.006	0.233
AMOUNT REIMBURSED	2341.675	2454.470	2456.891	2346.728	2349.330	2191.263	0.132

The share of episode payments going to SNFs has not changed for either patient group. In fact, the only significant change we observe in post-hospital care spending is a doubling of the Home Health agency share of episode payments for simple pneumonia, but this share still remains less than two percent of total episode payments.

Figure 5.2 shows the distributions of episode spending for pneumonias for 1981 and 1986. The figure suggests that there has been a marked compression or reimbursement amounts in 1986, much more tightly centered around a value about 75% of the mean. There are also fewer cases in the extreme right (outlier) tail; over $16,000 per episode.

Geographic Use Patterns. Table 5.6 describes the locational pattern of admissions and use rates for persons located in urban and rural areas. For both types of pneumonias these data suggest that rural beneficiaries frequently use local hospitals and are tending to be more likely to do so over time. For both types of pneumonias rural beneficiaries are quite likely to be admitted to rural hospitals relative to the experience for the other tracers. On the other hand, the fraction of rural beneficiaries being admitted to urban hospitals has increased significantly over the period--or: up from 11 to about 20 percent for infections and up from 14 to about 16 percent for simple pneumonia. There are no indications of significant trends in the transfer rates for patients from different locations.

Days of care, including transfer, readmission, and rehospitalization days per episode have fallen significantly for both types of patients in both types of areas. Total days of care are about 50 percent higher for the infection patients. Note also that persons from urban areas have episodes that make more intensive use of hospital services than their rural counterparts.

Reimbursements for physicians are also much higher in urban areas and much higher for the infection cases than for simple pneumonias. Payments to physicians over the episode for lung infections have not tended to decrease relative to inflation, although payments to physicians for simple pneumonias have not kept pace with inflation in either urban or rural areas.

Rates of access to post-hospital care (SNF or HHA) within the seven-day post-period have generally gone up for both patient groups and for both urban and rural patients. For infection patients, urban patients going to urban hospitals are about twice as likely to receive post-hospital care within seven days than their counterparts in rural areas who go to rural hospitals. For infections, the vulnerable group, rural beneficiaries going to urban hospitals, have post-hospital-care access rates that are too unstable to see a trend. For simple pneumonias, we do not see such marked differences in post-hospital-

Figure 5.2

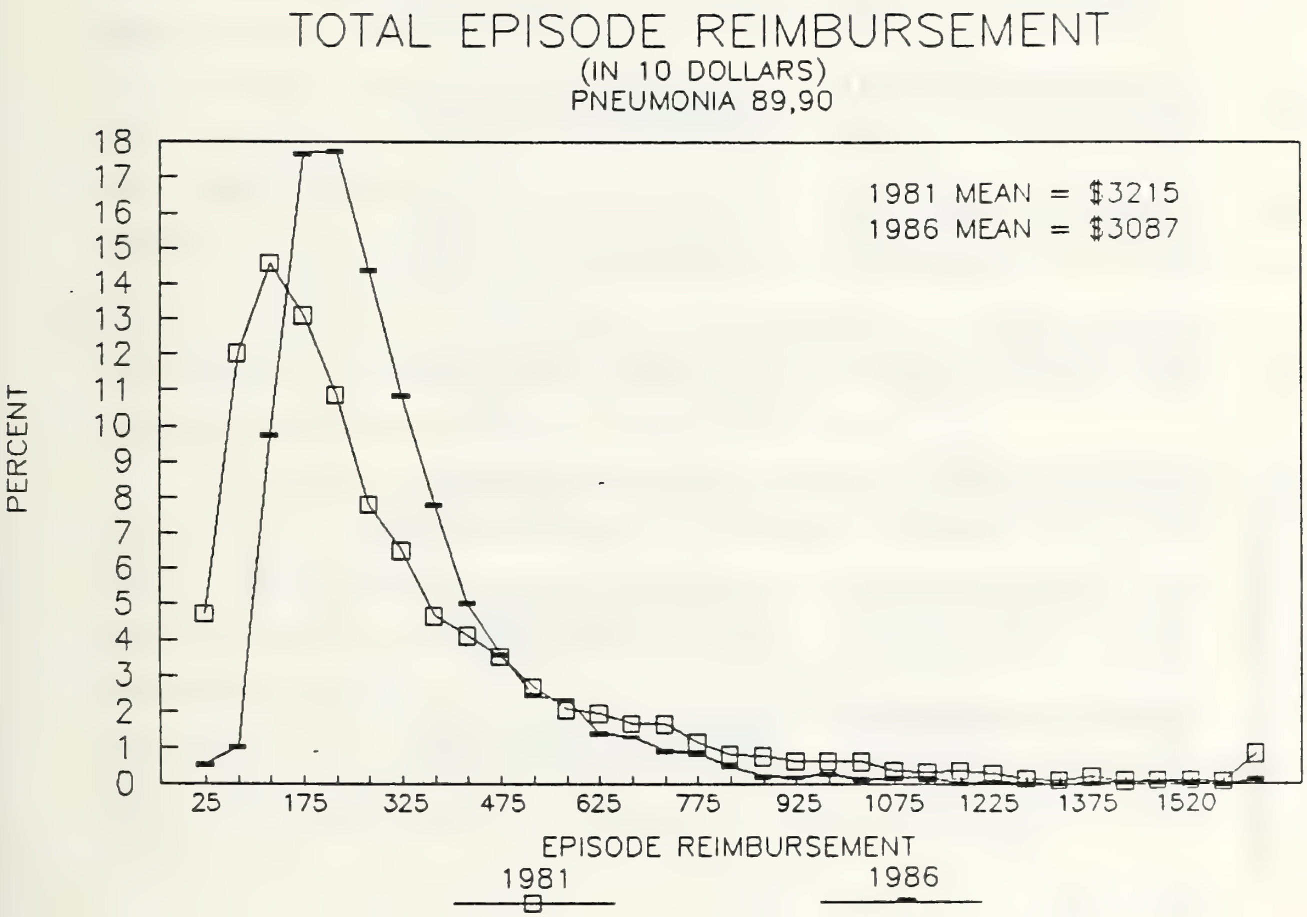

TOTAL EPISODE REIMBURSEMENT
(IN 10 DOLLARS)
PNEUMONIA 89,90
1981 MEAN = $3215
1986 MEAN = $3087
PERCENT
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
25
175
325
475
625
775
925
1075
1225
1375
1520
EPISODE REIMBURSEMENT
1981
1986

Table 5.6

GEOGRAPHIC USE PATTERNS: PNEUMONIA

DRG 79.80 (INFECT & INFLA)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.868	0.733	0.808	0.726	0.789	0.804	0.542
% RURAL RESIDENCE	0.368	0.467	0.384	0.367	0.340	0.379	0.246
% IN RURAL HOSPITALS	0.355	0.413	0.352	0.319	0.294	0.322	0.047
% RURAL BENEF IN URBAN HOSPITALS	0.107	0.143	0.125	0.215	0.157	0.211	0.032
RURAL EXT TRANSFERS(HOSP)	0.037	0.065	0.023	0.027	0.017	0.028	0.241
RURAL BENE EXT TRANS	0.036	0.057	0.021	0.023	0.007	0.030	0.229
URBAN BENE EXT TRANS	0.000	0.000	0.013	0.000	0.011	0.011	0.609
RURAL DAYS OF CARE	13.929	12.371	16.042	10.785	10.171	10.699	0.030
URBAN DAYS OF CARE	14.688	14.308	13.896	13.032	13.146	12.234	0.015
RURAL MD REIMB	338.286	282.419	362.386	365.221	253.284	260.349	0.467
URBAN MD REIMB	570.708	576.826	522.749	487.653	610.355	431.227	0.445
RURAL 7 DAY PHC RATE	0.080	0.100	0.071	0.098	0.136	0.191	0.111
URBAN 7 DAY PHC RATE	0.152	0.105	0.173	0.218	0.252	0.245	0.014
RURAL/URBAN 7 DAY PHC RATE	0.200	0.286	0.125	0.122	0.107	0.200	0.330

DRG 89.90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.777	0.772	0.773	0.760	0.755	0.767	0.024
% RURAL RESIDENCE	0.438	0.441	0.435	0.450	0.446	0.459	0.033
% IN RURAL HOSPITALS	0.399	0.407	0.396	0.410	0.402	0.409	0.216
% RURAL BENEF IN URBAN HOSPITALS	0.142	0.141	0.149	0.148	0.158	0.155	0.068
RURAL EXT TRANSFERS(HOSP)	0.020	0.024	0.026	0.025	0.016	0.023	0.544
RURAL BENE EXT TRANS	0.019	0.023	0.026	0.021	0.015	0.020	0.233
URBAN BENE EXT TRANS	0.009	0.009	0.007	0.007	0.012	0.007	0.716
RURAL DAYS OF CARE	9.501	9.833	9.528	8.116	7.726	7.866	0.000
URBAN DAYS OF CARE	10.617	11.137	10.556	9.227	8.682	8.885	0.002
RURAL MD REIMB	232.793	225.101	228.988	211.515	193.933	189.304	0.013
URBAN MD REIMB	404.722	412.960	382.769	337.128	314.357	309.059	0.003
RURAL 7 DAY PHC RATE	0.051	0.051	0.075	0.090	0.118	0.118	0.016
URBAN 7 DAY PHC RATE	0.080	0.103	0.129	0.129	0.144	0.163	0.075
RURAL/URBAN 7 DAY PHC RATE	0.053	0.088	0.067	0.086	0.110	0.126	0.069

care access rates across patient groups. For all three groups of patients, the rates of seven-day post-hospital care access have more than doubled over the six-year period.

Interhospital Difference in Episode Utilization. Table 5.7 shows utilization differences for the four types of hospitals we consider. Here we examine only the simple pneumonias. Average length of stay for simple pneumonias does not vary substantially across different types of hospitals. Length of stay has declined significantly for all hospital types, particularly for the major medical centers; by 1986 the major medical centers had the lowest length of stay for these cases. There are no apparent significant trends in transfer rates.

Trends in the use of post-hospital care are definitely apparent for different types of hospitals. The fractions of beneficiaries using SNF over HHA services within seven days of discharge are higher for all types of hospitals, but the differences are significant only for government and non-profit hospitals. We do not see marked differences in post-hospital care access rates across hospital types. In terms of the Medicare payments for the post portion of the episode, we do not see any trends nor sizable differences across hospital types, with post-period portion of episode costs remaining at about nine-ten percent of total episode payments.

The composition of payments made to physicians does seem to have changed over the period. The ratio of ambulatory to in-patient physician reimbursements is much lower in teaching hospitals relative to the other types of hospitals. Over the six-year period the fraction of physician reimbursements being made for ambulatory care has been reduced significantly for all types of hospitals except teaching. The total episode payments are much higher for teaching hospital admissions and much lower for admissions to government-owned hospitals. The only trend that is apparent in these data is a marginally significant reduction in reimbursement levels in proprietary hospitals.

Table 5.7

INTER HOSPITAL DIFFERENCES IN EPISODE: PNEUMONIA

DRG 89.90 (SIMPLE PNEU)

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LOS FOR HEAVY TEACHING	10.184	11.514	11.169	7.934	8.056	7.530	0.002
LOS FOR GOVERNMENT	9.186	9.194	8.983	8.103	7.246	7.895	0.007
LOS FOR PROPREITARY	9.601	10.712	10.024	8.767	8.218	8.217	0.010
LOS FOR NON-PROFIT	10.252	10.690	10.141	8.725	8.416	8.575	0.001
SOME PHC IN 7 DAYS,TEACHING	0.140	0.085	0.130	0.140	0.121	0.134	0.482
SOME PHC IN 7 DAYS,GOVERNMENT	0.044	0.060	0.065	0.087	0.107	0.130	0.020
SOME PHC IN 7 DAYS,PROPREITARY	0.084	0.091	0.143	0.122	0.158	0.158	0.148
SOME PHC IN 7 DAYS,NON-PROFIT	0.069	0.090	0.110	0.115	0.134	0.141	0.044
RATIO OF MD REIMB TO INPAT,TEACHING	0.132	0.115	0.139	0.152	0.086	0.098	0.488
RATIO OF MD REIMB TO INPAT,GOVERNMENT	0.234	0.244	0.283	0.176	0.221	0.155	0.048
RATIO OF MD REIMB TO INPAT,PROPREITARY	0.349	0.298	0.239	0.180	0.147	0.136	0.015
RATIO OF MD REIMB TO INPAT,NON-PROFIT	0.232	0.315	0.312	0.156	0.135	0.158	0.008
% WITH EXTERNAL TRANSFERS,TEACHING	0.000	0.000	0.000	0.000	0.024	0.030	0.120
% WITH EXTERNAL TRANSFERS,GOVERNMENT	0.020	0.022	0.022	0.020	0.016	0.023	0.415
% WITH EXTERNAL TRANSFERS,PROPREITARY	0.012	0.016	0.020	0.018	0.006	0.012	0.400
% WITH EXTERNAL TRANSFERS,NON-PROFIT	0.011	0.012	0.012	0.010	0.014	0.007	0.522
% EPI COST POST,TEACHING	0.092	0.088	0.068	0.099	0.114	0.091	0.132
% EPI COST POST,GOVERNMENT	0.101	0.112	0.107	0.112	0.106	0.121	0.295
% EPI COST POST,PROPREITARY	0.098	0.092	0.111	0.112	0.105	0.110	0.227
% EPI COST POST,NON-PROFIT	0.091	0.093	0.100	0.100	0.101	0.101	0.116
TOTAL EPISODE REIMB,TEACHING	4879.632	5560.478	4724.649	5178.625	5183.727	4487.259	0.776
TOTAL EPISODE REIMB,GOVERNMENT	2463.044	2527.702	2616.401	2625.481	2537.415	2557.154	0.508
TOTAL EPISODE REIMB,PROPREITARY	3602.015	3884.803	4103.235	3466.174	3655.425	3333.448	0.093
TOTAL EPISODE REIMB,NON-PROFIT	3389.136	3519.472	3489.504	3402.874	3374.656	3160.048	0.150

6.0 HERNIA CASES

Hernia episodes were subdivided into three groups. Admissions to DRGs 161 and 162 were divided into complicated hernias, bilateral hernia procedures, and unilateral hernia procedures. These separate categories of cases are preserved in the tables that follow. The discussion follows the order of the seven groups of measures noted earlier:

- Features of admitted cases
- Use of hospital services
- Part B service use
- Post-hospital SNF and HHA services
- Medicare expenditures for the episode
- Geographic use patterns
- Interhospital differences

On each of the seven tables that follow we report the p-values for the difference of means between 1981-83 and 1984-86.

Features of Admitted Cases. Table 6.1 describes the features of the hernia case we studied. The complicated group is distinguishable from the others in having cases that are older, more likely to be female, and having higher pre-period spending levels and use rates for services.

Very few trends in beneficiary characteristics are evident in these data. For unilateral hernias there is a slight increase over the six-year period in the average age and an increase in the likelihood that admitted persons will have had HHA services within the 30-day prior period. For bilateral hernias there are also indications of an increase in average age, a decrease in the percent female, and an increase in total Medicare reimbursement in the pre-60-day period. There are no indications of trend in the complicated cases.

These data suggest that it is probably useful to segregate the complicated cases from the other and that there are not marked changes in the characteristics of beneficiaries being admitted for these procedures over time. We are concerned, however, that the unilateral hernias may be subject to severity increases over time as outpatient department and day-surgery trends may skim the easier cases of this type, resulting in an average increase in overall severity. While this may be a threat, we see only slight evidences of increases in pre-period HHA use and about a one-half year

Table 6.1

FEATURES OF ADMITTED CASES: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	75.255	76.295	76.601	76.324	76.521	76.263	0.484
% FEMALE	0.245	0.205	0.136	0.135	0.147	0.123	0.139
% NON-WHITE	0.094	0.082	0.115	0.135	0.109	0.110	0.182
BENEFICIARY MEDICARE STATUS CODE=AGED	0.943	0.967	0.975	0.962	0.967	0.947	0.778
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.000	0.000	0.000	0.000	0.002	0.000	0.374
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.009	0.025	0.004	0.016	0.014	0.020	0.555
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	54.019	43.919	34.075	37.915	49.581	46.327	0.933
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.019	0.074	0.041	0.032	0.033	0.057	0.840
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	75.047	57.066	46.280	62.919	78.128	82.812	0.216

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	71.214	72.303	72.311	72.360	72.549	73.288	0.162
% FEMALE	0.083	0.075	0.105	0.051	0.064	0.077	0.118
% NON-WHITE	0.114	0.052	0.059	0.066	0.075	0.071	0.844
BENEFICIARY MEDICARE STATUS CODE=AGED	0.917	0.941	0.951	0.952	0.930	0.947	0.610
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.000	0.000	0.000	0.000	0.000	0.000	.
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.004	0.005	0.005	0.004	0.000	0.009	0.952
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	35.795	37.888	30.785	36.807	46.267	40.046	0.149
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.017	0.038	0.033	0.044	0.018	0.019	0.815
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	50.716	48.441	43.058	50.669	59.792	55.084	0.089

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY AGE AS OF ADMISSION DATE	71.988	71.914	72.285	72.437	72.418	72.621	0.030
% FEMALE	0.111	0.102	0.103	0.098	0.091	0.109	0.382
% NON-WHITE	0.080	0.086	0.078	0.085	0.102	0.077	0.453
BENEFICIARY MEDICARE STATUS CODE=AGED	0.934	0.939	0.937	0.938	0.935	0.939	0.708
% WITH SNF STAYS IN PRE 30 DAY PERIOD	0.001	0.000	0.000	0.000	0.000	0.000	0.327
% WITH HHA VISITS IN PRE 30 DAY PERIOD	0.003	0.004	0.003	0.010	0.009	0.006	0.029
PHYSICAN PAYMENTS IN PRE 30 DAY PERIOD	43.647	41.393	34.475	36.803	46.633	45.518	0.491
% WITH HOSPITAL STAYS IN PRE 60 PERIOD	0.044	0.041	0.036	0.039	0.039	0.036	0.457
TOTAL MEDICARE REIMB IN PRE 60 PERIOD	55.068	53.548	45.375	49.737	62.499	60.473	0.278

increase in average age on admission. It is not clear from these data whether a severity increase has occurred.

Use of Hospital Services. Table 6.2 indicates aspects of hospital utilization for the three types of hernia cases. The pattern of length of stay is consistent with our expectations that there were differences among these groups of hernia cases. Length of stay is highest in the complicated cases and lowest in the unilateral cases. Length of stay has decreased by more than two days in each of these groups. About 25 percent of this decrease is explained by a significant reduction in pre-surgical days.

There is a much higher rate of ICCU admissions in the complicated cases, but across groups there has been no trend in ICCU use. For all three groups there has been a substantial increase in the ratio of ancillary to total charges.

The use of subsequent hospitalizations differs among the three types of cases. For the complicated cases, there is no observable increase in transfers to other hospitals, readmissions to the same hospital, or rehospitalizations within the seven-day post-period. For unilateral hernias, there has been no change in external transfer rates or rehospitalizations; but there has been a statistically significant increase in the fraction of cases being readmitted within the seven-day post-period. For bilateral hernias, we see that transfer rates are lower, rehospitalization rates are lower, and readmission rates have not changed.

Part B Utilization. As shown in Table 6.3, payments to physicians are highest for the complicated cases and lowest for the unilateral hernias. There has been a significant downward trend in inflation-adjusted reimbursements to physicians for services rendered in the inpatient setting for all three groups. There have also been slight upward trends in real reimbursements for physician spending for services rendered in ambulatory settings for all groups; this trend is significant, however, only for the unilateral hernia repair group, where the sample size is much larger. This pattern, similar to the pattern for other tracers we study, is indicative of substitution of ambulatory visits for inpatient visits.

There is little other evidence that Part B services have changed much for hernia repair cases. The use of DME is up, but significant only for the complicated hernia repairs. Outpatient department use over the 30-day pre- to 30-day post time frame has not changed. Nor has the use rate for Emergency Room visits. As with the other tracers we study, we do see that the outpatient department bills are more likely to have procedure codes present for all three groups of cases.

Table 6.2

USE OF HOSPITAL SERVICES: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	7.679	7.525	7.383	6.746	5.846	5.247	0.023
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.000	0.000	0.004	0.003	0.002	0.003	0.365
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.000	0.000	0.000	.
INT & COR CARE UNIT DAYS > 0	0.142	0.090	0.136	0.116	0.102	0.083	0.307
TOT ANCIL CHARGES / TOTAL CHARGES	0.600	0.612	0.622	0.642	0.683	0.685	0.018
# OF PRE SURGERY DAYS	1.371	1.367	1.296	1.295	1.024	0.937	0.078
# READMISSIONS W/IN 7 DAY POST PERIOD	0.066	0.016	0.012	0.027	0.033	0.023	0.841
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.000	0.000	0.021	0.005	0.007	0.003	0.832

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	6.358	5.876	5.897	5.020	4.541	4.164	0.007
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.004	0.005	0.005	0.002	0.000	0.000	0.006
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.000	0.003	0.000	0.374
INT & COR CARE UNIT DAYS > 0	0.017	0.031	0.015	0.015	0.015	0.019	0.390
TOT ANCIL CHARGES / TOTAL CHARGES	0.583	0.621	0.614	0.636	0.677	0.694	0.039
# OF PRE SURGERY DAYS	1.374	1.354	1.434	1.088	0.887	0.749	0.009
# READMISSIONS W/IN 7 DAY POST PERIOD	0.009	0.005	0.021	0.020	0.021	0.009	0.432
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.009	0.007	0.008	0.002	0.000	0.000	0.001

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LENGTH OF STAY	5.777	5.325	5.074	4.176	3.760	3.531	0.005
EXTERNAL TRANSFERS TO OTHER HOSPITALS	0.001	0.002	0.002	0.002	0.001	0.003	0.866
INTERNAL TRANSFERS W/IN SAME HOSPITAL	0.000	0.000	0.000	0.000	0.000	0.001	0.374
INT & COR CARE UNIT DAYS > 0	0.026	0.021	0.023	0.017	0.021	0.022	0.160
TOT ANCIL CHARGES / TOTAL CHARGES	0.584	0.594	0.615	0.644	0.676	0.702	0.017
# OF PRE SURGERY DAYS	1.478	1.358	1.304	1.031	0.847	0.722	0.008
# READMISSIONS W/IN 7 DAY POST PERIOD	0.009	0.010	0.012	0.018	0.016	0.016	0.005
# REHOSPITALIZATIONS W/IN POST 7 PERIOD	0.002	0.002	0.002	0.002	0.001	0.004	0.606

Table 6.3

PART B SERVICES: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	768.425	693.119	652.375	629.602	610.899	537.050	0.064
MD OFFICE REIMB-(30-30)	34.340	40.254	42.760	37.182	55.930	55.539	0.193
RATIO OF MD REIMB. TO INPAT (30-30)	0.517	0.544	0.684	0.474	0.444	0.483	0.097
% WITH DME (30-30)	0.047	0.057	0.045	0.078	0.100	0.067	0.038
OPD CLINIC VISITS (30-30)	0.066	0.049	0.046	0.056	0.040	0.056	0.745
ER CLINIC VISITS (30-30)	0.175	0.066	0.112	0.116	0.121	0.130	0.883
% WITH OPD BILLS W/SURG (30-30)	0.000	0.008	0.004	0.011	0.036	0.033	0.053

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	748.590	682.808	725.027	620.706	607.345	516.733	0.022
MD OFFICE REIMB-(30-30)	44.677	35.164	32.073	38.394	42.307	47.024	0.310
RATIO OF MD REIMB. TO INPAT (30-30)	0.647	0.756	0.769	0.523	0.525	0.620	0.029
% WITH DME (30-30)	0.031	0.026	0.028	0.026	0.039	0.025	0.729
OPD CLINIC VISITS (30-30)	0.086	0.057	0.037	0.020	0.037	0.075	0.499
ER CLINIC VISITS (30-30)	0.079	0.065	0.062	0.070	0.064	0.087	0.554
% WITH OPD BILLS W/SURG (30-30)	0.000	0.007	0.008	0.020	0.028	0.031	0.007

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
MD INPATIENT SERVICE REIMB-(30-30)	565.115	527.755	514.880	475.503	435.371	383.572	0.027
MD OFFICE REIMB-(30-30)	33.131	30.937	31.536	34.207	43.050	44.893	0.058
RATIO OF MD REIMB. TO INPAT (30-30)	0.626	0.663	0.727	0.536	0.465	0.444	0.009
% WITH DME (30-30)	0.024	0.029	0.036	0.034	0.040	0.043	0.106
OPD CLINIC VISITS (30-30)	0.086	0.068	0.073	0.070	0.088	0.072	0.897
ER CLINIC VISITS (30-30)	0.114	0.072	0.076	0.070	0.102	0.089	0.999
% WITH OPD BILLS W/SURG (30-30)	0.002	0.004	0.006	0.013	0.027	0.034	0.031

Description of Selected Variables:

MD Inpatient Service Reimb. (30-30) = Part B Inpatient Reimb. Amt. Pre 30 to Post 30

MD Office Reimb. (30-30) = Part B Physician Reimb. Amt. Pre 30 day and Post 30 day periods.

Ratio of MD Reimb. to Inpat. (30-30) = (MD Inpat. Service Reimb. + MD Office Reimb.)/Hospital Inpat. Stay Reimb.

Post-Hospital SNF and HHA Service Utilization. Table 6.4 contains measures of SNF and HHA service use in the post-discharge period. Post-hospital care use is very infrequent for persons with inguinal hernia repair. Use rates are somewhat higher for the complicated cases than the others, and there is an indication of a slight elevation in post-hospital care use rates for the period seven days following the stay relative to the background use level for these services.

We see no trend whatsoever in the rate of SNF use. We do see a higher probability of discharges getting HHA services within the post-seven-day period in all patient groups, although the trend is significant only in the case of unilateral hernia repair. Overall, 7 day post hospital care (SNF, HHA) access rate has increased for all tracers, though the increase is not statistically significant for the bilateral subtracer.

The accompanying figure (6.1) describes home health use post discharge in more detail. The left panel shows the likelihood of a beneficiary initiating HHA care in any week in 1981 and 1986. These charts are to be interpreted as hazard rates; how does the intervention of a hospital stay alter the likelihood of HHA use? These figures show that for all 3 hernia tracers, post (1986) period access is different in only one way; the likelihood of using HHA care is higher in the first week post discharge. For other points in time, there basically is no change in HHA access rates (though the background access rate may be slightly higher in 1986 for the simpler cases).

The right side of the chart shows intensity of HHA visits per week, for persons using at least 1 visit. The basic finding is that intensity is up for the complicated and bilateral patients and down for unilateral cases. The latter finding contradicts our suggestion that severity might be higher for simple hernias due to more day surgery; the HHA visits intensity data would suggest that persons getting HHA care are not in need of as much care in 1986 as in 1981.

Expenditures for the Episode. Table 6.5 shows total episode payments by Medicare to be clearly different for the three groups of patients, being highest for the complicated cases and lowest for the unilateral cases. There is a significant downward trend in total Medicare reimbursements for complicated and bilateral procedures and a slight, though insignificant, downward trend for the unilateral cases. Most of the decrease seems to be a reduction in hospital payments, which have become much more compressed across the three types of cases, no doubt the result of DRG payment levels.

Table 6.4

POST HOSPITAL SERVICES: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.038	0.008	0.008	0.016	0.009	0.003	0.470
# COVERED SNF DAYS IN POST 30 PERIOD	0.491	0.107	0.103	0.378	0.218	0.103	1.000
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.009	0.049	0.053	0.049	0.085	0.070	0.157
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.009	0.049	0.058	0.054	0.095	0.083	0.114
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.019	0.049	0.066	0.065	0.111	0.090	0.083
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.038	0.049	0.074	0.076	0.114	0.103	0.048
TOTAL # HHA VISITS IN POST 7 PERIOD	0.019	0.160	0.137	0.160	0.229	0.186	0.146
TOTAL # HHA VISITS IN POST 14 PERIOD	0.019	0.259	0.247	0.296	0.449	0.353	0.101
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	1.000	0.817	0.768	0.781	0.729	0.807	0.296
# HHA THERAPY VISITS IN POST 14 PERIOD	0.000	0.008	0.008	0.005	0.012	0.003	0.730
POST HOSP CARE RATE IN POST 7 PERIOD	0.047	0.057	0.062	0.065	0.095	0.073	0.088

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.000	0.005	0.000	0.000	0.005	0.006	0.421
# COVERED SNF DAYS IN POST 30 PERIOD	0.000	0.040	0.000	0.000	0.072	0.111	0.246
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.013	0.021	0.021	0.011	0.034	0.028	0.464
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.013	0.021	0.021	0.011	0.034	0.028	0.464
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.017	0.026	0.026	0.013	0.034	0.037	0.567
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.022	0.028	0.028	0.015	0.034	0.040	0.664
TOTAL # HHA VISITS IN POST 7 PERIOD	0.024	0.057	0.049	0.031	0.110	0.098	0.244
TOTAL # HHA VISITS IN POST 14 PERIOD	0.041	0.109	0.098	0.072	0.199	0.160	0.230
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.850	0.760	0.744	0.703	0.698	0.844	0.567
# HHA THERAPY VISITS IN POST 14 PERIOD	0.000	0.002	0.000	0.000	0.005	0.003	0.309
POST HOSP CARE RATE IN POST 7 PERIOD	0.013	0.026	0.021	0.011	0.039	0.034	0.435

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
# COVERED SNF ADMITS IN POST 7 PERIOD	0.002	0.001	0.001	0.001	0.002	0.002	0.952
# COVERED SNF DAYS IN POST 30 PERIOD	0.024	0.040	0.012	0.014	0.017	0.008	0.225
% WITH HHA VISITS IN POST 07 DAY PERIOD	0.009	0.008	0.017	0.017	0.022	0.024	0.060
% WITH HHA VISITS IN POST 14 DAY PERIOD	0.010	0.009	0.019	0.019	0.024	0.027	0.058
% WITH HHA VISITS IN POST 30 DAY PERIOD	0.011	0.011	0.021	0.023	0.025	0.032	0.050
% WITH HHA VISITS IN POST 60 DAY PERIOD	0.012	0.013	0.022	0.024	0.027	0.036	0.055
TOTAL # HHA VISITS IN POST 7 PERIOD	0.027	0.022	0.042	0.039	0.060	0.069	0.076
TOTAL # HHA VISITS IN POST 14 PERIOD	0.054	0.042	0.083	0.080	0.117	0.137	0.068
# HHA SKL NUR VIS/TOT HHA VIS;(POST 30)	0.707	0.714	0.746	0.729	0.815	0.766	0.158
# HHA THERAPY VISITS IN POST 14 PERIOD	0.001	0.002	0.002	0.002	0.003	0.003	0.070
POST HOSP CARE RATE IN POST 7 PERIOD	0.011	0.010	0.019	0.018	0.023	0.026	0.060

Figure 6.1

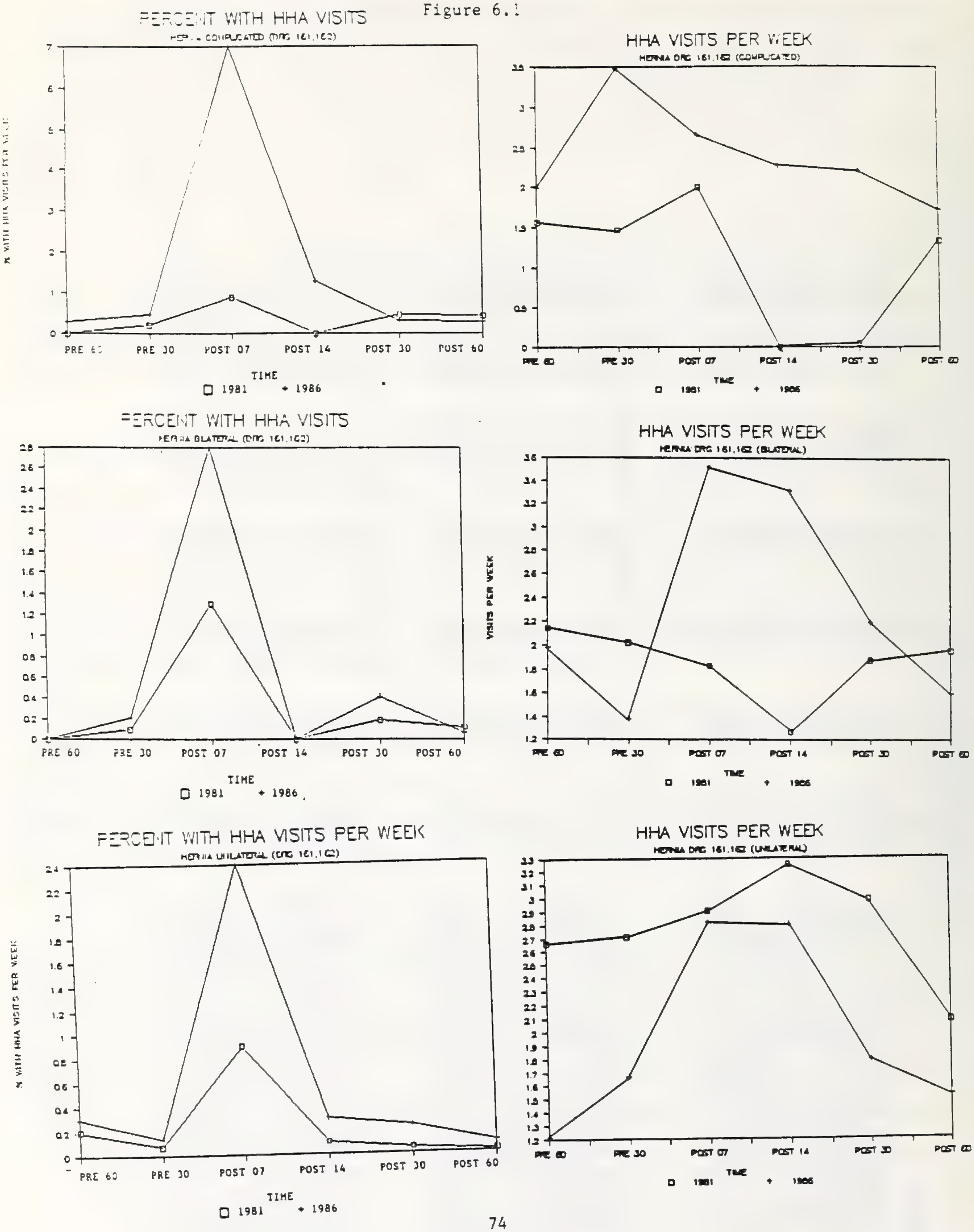

PERCENT WITH HHA VISITS
HERNIA COMPLICATED (DRG 161,162)
% WITH HHA VISITS PER WEEK
0
1
2
3
4
5
6
7
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
HERNIA DRG 161,162 (COMPLICATED)
0
0.5
1
1.5
2
2.5
3
3.5
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
PERCENT WITH HHA VISITS
HERNIA BILATERAL (DRG 161,162)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
HERNIA DRG 161,162 (BILATERAL)
VISITS PER WEEK
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
PERCENT WITH HHA VISITS PER WEEK
HERNIA UNILATERAL (DRG 161,162)
% WITH HHA VISITS PER WEEK
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986
HHA VISITS PER WEEK
HERNIA DRG 161,162 (UNILATERAL)
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
PRE 60
PRE 30
POST 07
POST 14
POST 30
POST 60
TIME
□ 1981
+ 1986

Table 6.5

EXPENDITURES & INTENSITY OF EPISODE: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	3090.396	2823.725	2787.107	2643.445	2646.969	2157.630	0.091
% EPI REIMB PRE	0.022	0.017	0.020	0.023	0.029	0.033	0.059
% EPI REIMB POST	0.066	0.036	0.061	0.067	0.073	0.071	0.154
% EPI REIMB POST (EX REHOSP & READM)	0.022	0.018	0.023	0.025	0.034	0.035	0.046
% EPI INPATIENT	0.912	0.946	0.919	0.910	0.898	0.895	0.090
% EPI INPATIENT (INC REHOSP & READM)	0.956	0.965	0.957	0.952	0.938	0.932	0.049
% EPI MD	0.288	0.300	0.297	0.261	0.258	0.276	0.011
% EPI PART B	0.297	0.307	0.306	0.274	0.275	0.294	0.039
% EPI HHA	0.000	0.003	0.006	0.006	0.010	0.011	0.052
% EPI SNF	0.004	0.001	0.001	0.005	0.004	0.001	0.436
AMOUNT REIMBURSED	1772.953	1867.885	1809.539	1637.538	1540.435	1274.697	0.041

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	2528.118	2272.154	2371.876	2184.206	2235.209	1927.632	0.085
% EPI REIMB PRE	0.021	0.023	0.020	0.021	0.026	0.027	0.169
% EPI REIMB POST	0.038	0.036	0.036	0.042	0.047	0.060	0.064
% EPI REIMB POST (EX REHOSP & READM)	0.019	0.018	0.020	0.016	0.023	0.028	0.444
% EPI INPATIENT	0.942	0.941	0.944	0.937	0.927	0.913	0.072
% EPI INPATIENT (INC REHOSP & READM)	0.960	0.960	0.960	0.963	0.951	0.945	0.284
% EPI MD	0.333	0.351	0.341	0.301	0.295	0.294	0.001
% EPI PART B	0.342	0.359	0.351	0.311	0.306	0.306	0.001
% EPI HHA	0.001	0.002	0.003	0.001	0.003	0.004	0.266
% EPI SNF	0.000	0.000	0.000	0.000	0.001	0.000	0.397
AMOUNT REIMBURSED	1589.153	1399.838	1482.303	1364.296	1380.479	1115.446	0.116

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
TOT EPI REIMB (PRE30-POST30)	2118.258	1950.844	1885.438	1995.490	1982.710	1713.419	0.489
% EPI REIMB PRE	0.026	0.024	0.024	0.024	0.030	0.034	0.213
% EPI REIMB POST	0.037	0.038	0.038	0.042	0.044	0.053	0.065
% EPI REIMB POST (EX REHOSP & READM)	0.021	0.019	0.021	0.019	0.021	0.026	0.481
% EPI INPATIENT	0.937	0.938	0.938	0.934	0.926	0.913	0.102
% EPI INPATIENT (INC REHOSP & READM)	0.953	0.957	0.955	0.957	0.949	0.940	0.292
% EPI MD	0.315	0.318	0.323	0.270	0.248	0.255	0.001
% EPI PART B	0.322	0.327	0.333	0.280	0.260	0.269	0.001
% EPI HHA	0.001	0.001	0.002	0.002	0.003	0.004	0.027
% EPI SNF	0.000	0.001	0.000	0.000	0.000	0.000	0.542
AMOUNT REIMBURSED	1357.983	1213.369	1197.777	1301.275	1312.116	1078.513	0.793

Part B payments, which are almost entirely physician payments in this case, have fallen in real terms and have fallen relative to their share of the total episode reimbursements. Payments to Part B activities are about 30 percent of episode costs.

Both pre- and post-episode components of total episode reimbursement have increased slightly. The pre-period reimbursements represent 2-3 percent of total episode payments and appear to be higher in all three patient groups but statistically significant only for the complicated hernia repairs. The first measure of post hospital care (including subsequent hospital stays) shows a statistically significant increase for the bilateral and unilateral subtracers. The second measure shows a statistically significant increase for only the complicated subtracer; the other two subtracers remain virtually flat across 1981 to 1986. SNF payments are insignificant for these cases and HHA payments as a fraction of the episode costs are higher in both the complicated and unilateral hernia repair cases, but still represent a trivial portion of episode costs.

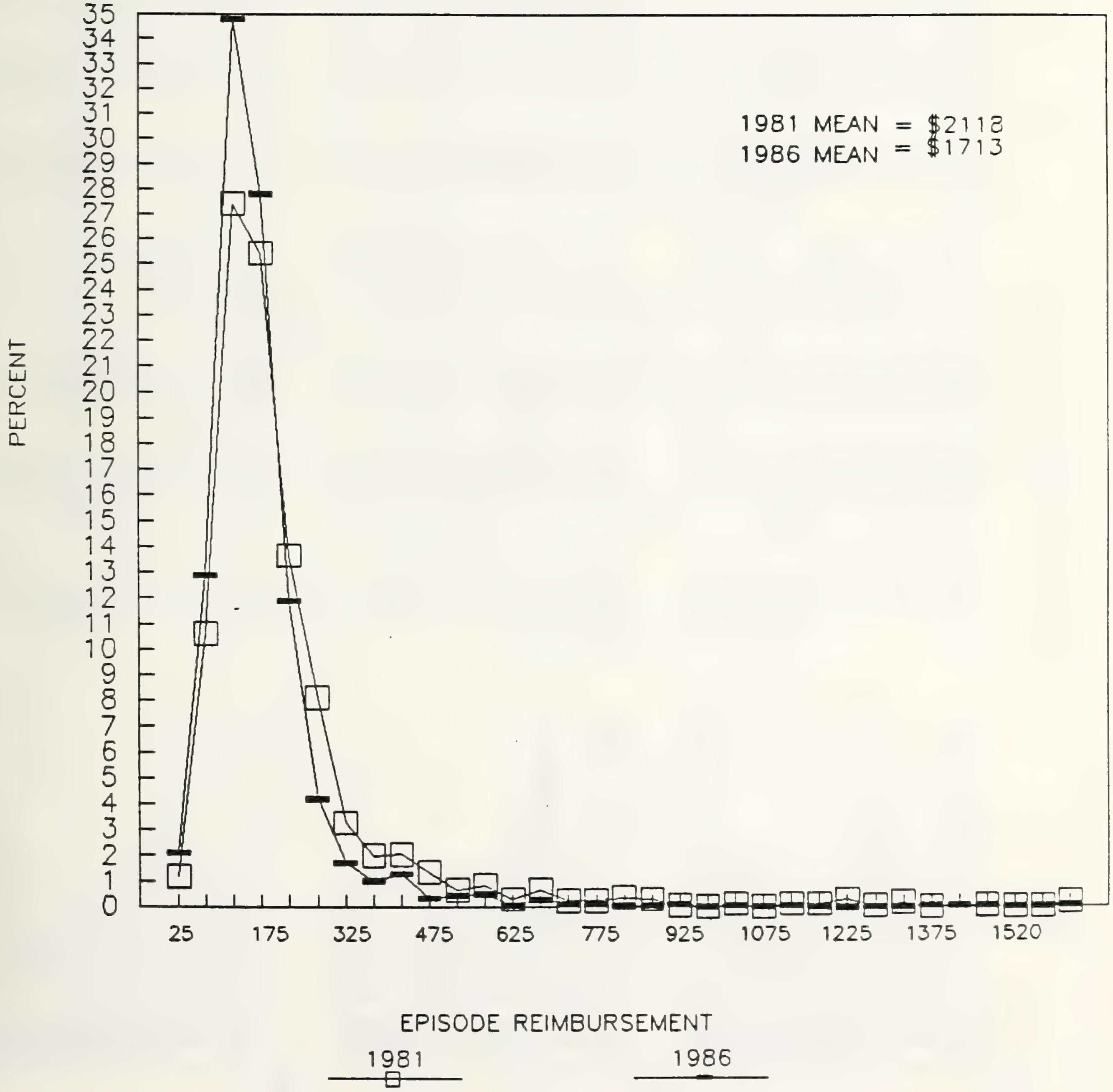
Figure 6.2 shows the distributions of episode spending for unilaterial hernia repair for 1981 and 1986. The figure suggests that there has been a slight compression of reimbursement amounts in 1986, somewhat more tightly centered around the mode.

Geographic Use Patterns. Table 6.6 shows the admission patterns in rural and urban areas as well as utilization rates for beneficiaries in these two kinds of areas. Hernia repairs are generally treated in hospitals that are close to the beneficiary's residence. There have been some changes in referral patterns. For complicated cases, we do see that there has been a significant increase in the fraction of rural beneficiaries who are being treated in urban hospitals. On the other hand, we see a reduction in the fraction of rural beneficiaries treated in urban hospitals for the bilateral hernia repair group. We see no change in referral patterns for unilateral hernias. However, we do see fewer transfers of unilateral cases from rural hospitals.

Days of care for the episode, including rehospitalizations, readmits, and transfers, are generally down for all patient groups in both urban and rural locations. Differences in days of care in urban and rural settings are not not very pronounced, with the exception of the bilateral hernia category, which consistently shows fewer days of care for persons treated in urban hospitals.

There are substantial differences in payments made to physicians for episodes involving urban or rural hospitals. There are clear trends for all three groups of cases and in both urban and rural areas, showing that level of physician reimbursement has been increasing slower than the rate of general medical care inflation. This trend is not significant for the complicated cases. Use rates for post-hospital care are very unstable for the complicated and bilateral groups due to small sample sizes and infrequent

Figure 6.2



TOTAL EPISODE REIMBURSEMENT
(IN 10 DOLLARS)
HERNIA–UNILATERAL

1981 MEAN = $2118
1986 MEAN = $1713

Table 6.6

GEOGRAPHIC USE PATTERNS: HERNIA

COMPLICATED

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.840	0.770	0.770	0.784	0.754	0.793	0.566
% RURAL RESIDENCE	0.283	0.385	0.333	0.349	0.363	0.327	0.719
% IN RURAL HOSPITALS	0.236	0.320	0.284	0.268	0.291	0.273	0.930
% RURAL BENEF IN URBAN HOSPITALS	0.233	0.170	0.210	0.263	0.255	0.235	0.082
RURAL EXT TRANSFERS(HOSP)	0.000	0.000	0.014	0.010	0.000	0.000	0.816
RURAL BENE EXT TRANS	0.000	0.000	0.012	0.008	0.007	0.010	0.395
URBAN BENE EXT TRANS	0.000	0.000	0.000	0.000	0.000	0.000	.
RURAL DAYS OF CARE	7.233	8.702	8.222	6.023	6.340	5.296	0.015
URBAN DAYS OF CARE	7.851	6.787	7.045	7.199	5.628	5.265	0.151
RURAL MD REIMB	505.367	599.682	606.714	502.769	529.307	454.245	0.129
URBAN MD REIMB	885.122	751.673	674.838	702.637	659.522	582.996	0.159
RURAL 7 DAY PHC RATE	0.043	0.103	0.063	0.021	0.132	0.080	0.836
URBAN 7 DAY PHC RATE	0.055	0.013	0.065	0.085	0.078	0.057	0.184
RURAL/URBAN 7 DAY PHC RATE	0.000	0.250	0.042	0.051	0.100	0.167	0.922

BILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.716	0.754	0.763	0.752	0.719	0.765	0.972
% RURAL RESIDENCE	0.293	0.261	0.308	0.338	0.353	0.365	0.016
% IN RURAL HOSPITALS	0.205	0.202	0.203	0.266	0.294	0.300	0.001
% RURAL BENEF IN URBAN HOSPITALS	0.313	0.288	0.358	0.260	0.226	0.237	0.026
RURAL EXT TRANSFERS(HOSP)	0.021	0.012	0.000	0.008	0.000	0.000	0.290
RURAL BENE EXT TRANS	0.015	0.009	0.017	0.006	0.000	0.000	0.023
URBAN BENE EXT TRANS	0.000	0.003	0.000	0.000	0.000	0.000	0.374
RURAL DAYS OF CARE	7.119	6.126	6.267	5.279	4.526	4.508	0.012
URBAN DAYS OF CARE	6.195	5.868	5.779	4.929	4.571	3.985	0.009
RURAL MD REIMB	661.896	603.688	588.672	537.430	523.445	505.890	0.017
URBAN MD REIMB	785.943	713.176	786.578	671.126	660.726	532.081	0.051
RURAL 7 DAY PHC RATE	0.000	0.025	0.013	0.009	0.038	0.033	0.299
URBAN 7 DAY PHC RATE	0.019	0.026	0.026	0.010	0.037	0.041	0.605
RURAL/URBAN 7 DAY PHC RATE	0.000	0.024	0.000	0.020	0.050	0.000	0.409

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
BENEFICIARY COUNTY=HOSPITAL COUNTY	0.763	0.732	0.731	0.739	0.726	0.719	0.320
% RURAL RESIDENCE	0.337	0.377	0.351	0.350	0.378	0.412	0.314
% IN RURAL HOSPITALS	0.275	0.299	0.274	0.296	0.310	0.329	0.085
% RURAL BENEF IN URBAN HOSPITALS	0.230	0.256	0.295	0.239	0.247	0.249	0.468
RURAL EXT TRANSFERS(HOSP)	0.004	0.003	0.006	0.001	0.003	0.002	0.042
RURAL BENE EXT TRANS	0.003	0.004	0.004	0.002	0.002	0.000	0.031
URBAN BENE EXT TRANS	0.000	0.001	0.001	0.002	0.000	0.005	0.302
RURAL DAYS OF CARE	5.891	5.690	5.191	4.389	3.885	3.556	0.007
URBAN DAYS OF CARE	5.743	5.196	5.060	4.055	3.693	3.584	0.004
RURAL MD REIMB	445.945	439.684	442.742	416.712	376.853	343.741	0.040
URBAN MD REIMB	625.766	582.726	558.028	515.123	475.491	420.855	0.025
RURAL 7 DAY PHC RATE	0.002	0.009	0.011	0.016	0.027	0.032	0.033
URBAN 7 DAY PHC RATE	0.014	0.010	0.025	0.021	0.023	0.026	0.210
RURAL/URBAN 7 DAY PHC RATE	0.018	0.008	0.006	0.012	0.020	0.013	0.402

instances of post-hospital care use. For unilateral procedures, however, we see significant increases in the rate at which rural beneficiaries going to rural hospitals access some form of SNF or Home Health Service within seven days of discharge. Indeed, the rural post-hospital care access rate appears in 1985 and 1986 to be higher than the urban post-hospital care access rate. Note also that the vulnerable group of patients, those located in rural areas who have their surgery in urban hospitals, have a much lower rate of post-hospital care access.

Interhospital Differences in Episode Use. Table 6.7 shows several measures of utilization for four different types of hospitals. These data are presented only for unilateral procedures. There has been a large length-of-stay reduction for all types of hospitals. Interestingly, the lowest length of stay appears in major medical centers for these unilateral hernia cases. There is no significant transfer activity for hernia repair and no significant trends for transfer rates. The ratio of physician to hospital payments for the episodes are much lower for teaching hospitals and appear to be getting lower for all except government-owned hospitals.

Total episode cost appears to be lower for government and proprietary hospitals and relatively unchanged against trend. The portion of patient episodes cost that is incurred in the post-period represents three to four percent of costs and there are no large differences across types of hospitals. The significant upward trends are for proprietary and non-profit hospitals. Post-hospital care access rates in seven days post-discharge appear to be higher though noticeably so only in government and non-profit hospitals.

Table 6.7

INTER HOSPITAL DIFFERENCES IN EPISODE: HERNIA

UNILAT

	YEAR 81	YEAR 82	YEAR 83	YEAR 84	YEAR 85	YEAR 86	P VALUE
LOS FOR HEAVY TEACHING	6.206	5.300	5.297	4.456	4.300	3.186	0.032
LOS FOR GOVERNMENT	5.854	5.259	5.309	4.157	3.828	3.749	0.002
LOS FOR PROPREITARY	6.048	5.720	5.150	4.404	4.137	3.217	0.018
LOS FOR NON-PROFIT	5.685	5.287	4.987	4.126	3.628	3.602	0.004
SOME PHC IN 7 DAYS,TEACHING	0.032	0.025	0.000	0.058	0.018	0.014	0.543
SOME PHC IN 7 DAYS,GOVERNMENT	0.003	0.005	0.018	0.014	0.028	0.024	0.101
SOME PHC IN 7 DAYS,PROPREITARY	0.021	0.014	0.045	0.026	0.017	0.025	0.684
SOME PHC IN 7 DAYS,NON-PROFIT	0.011	0.009	0.016	0.016	0.024	0.028	0.059
RATIO OF MD REIMB TO INPAT,TEACHING	0.306	0.302	0.305	0.289	0.254	0.294	0.108
RATIO OF MD REIMB TO INPAT,GOVERNMENT	0.619	0.663	0.610	0.717	0.665	0.471	0.871
RATIO OF MD REIMB TO INPAT,PROPREITARY	0.780	0.743	0.833	0.635	0.523	0.477	0.011
RATIO OF MD REIMB TO INPAT,NON-PROFIT	0.620	0.671	0.765	0.483	0.414	0.431	0.007
% WITH EXTERNAL TRANSFERS,TEACHING	0.000	0.000	0.000	0.000	0.000	0.000	.
% WITH EXTERNAL TRANSFERS,GOVERNMENT	0.000	0.005	0.004	0.002	0.005	0.003	0.937
% WITH EXTERNAL TRANSFERS,PROPREITARY	0.005	0.000	0.000	0.000	0.000	0.000	0.374
% WITH EXTERNAL TRANSFERS,NON-PROFIT	0.001	0.001	0.002	0.002	0.000	0.004	0.578
% EPI COST POST,TEACHING	0.034	0.018	0.056	0.019	0.050	0.030	0.856
% EPI COST POST,GOVERNMENT	0.042	0.036	0.040	0.043	0.051	0.063	0.106
% EPI COST POST,PROPREITARY	0.040	0.035	0.036	0.040	0.050	0.051	0.064
% EPI COST POST,NON-PROFIT	0.035	0.039	0.037	0.043	0.041	0.052	0.091
TOTAL EPISODE REIMB,TEACHING	3176.651	2333.594	2844.481	2680.041	3172.281	2349.437	0.889
TOTAL EPISODE REIMB,GOVERNMENT	1815.085	1634.746	1700.449	1644.016	1574.321	1408.730	0.117
TOTAL EPISODE REIMB,PROPREITARY	2567.280	2244.945	2063.054	2046.997	1994.250	1685.391	0.108
TOTAL EPISODE REIMB,NON-PROFIT	2072.579	1969.658	1848.655	2043.209	2010.681	1796.901	0.901

7.0 SYNTHESIS

There appear to be significant trends in episodic practice patterns for the cases we examine. This section attempts a summary of these changes in two ways. First, we summarize the findings on seventeen of the key measures across the ten patient groups we study. Second, we use eleven measures for the four largest tracer categories to study Chernoff faces as a way to reflect change in episode content.

Summary. Table 7.1 contains the major findings from the earlier chapters in this paper. We report the direction of significant trends ($p \leq 0.10$) for seventeen measures of episode structure.

For hospital use, we see consistent evidence of length of stay reductions. When we observe surgery (hernias, hips), we see that only a fraction of the LOS reduction (25-30%) was due to pre-surgery or front-end day reductions; the balance is clearly a reduction in recuperative days in the hospital.

The change in length of stay brings with it a change in the mix of services provided in hospitals; reducing the provision of routine room and board and nursing services (due to fewer days) but without a proportional cut in use of testing and surgical services. Hence the ancillary intensity of the stay has risen in nine out of ten tracers. There is no evidence (except for TIAs) that patient access to ICCU services has fallen; in fact two tracers (stroke and lung infection) show increases in such access. The TIA reduction may, in fact, be a coding phenomenon, wherein average severity may well be falling due to inclusion of true strokes in that category in the pre-PPS period.

Transfer and readmit rates each have been affected by trend in 3 of 10 tracers. Transfers are lower in extracranial surgery (DRG 005), bilateral hernia repair and hip fracture repairs; no other significant changes are seen. We suspect that generally less transfer activity is the consequence of excess capacity and the desire of hospitals to internalize as much work as possible. It is not possible to say if this is good or bad in terms of quality of care. Readmission rates (to the same hospital), on the other hand, are up in three cases (stroke, unilateral hernia, and hip fractures). In the case of hernia we might be concerned that the substitution of day surgery for inpatient care may have increased average severity levels and readmit rates. For stroke and hip fractures, we have no basis for the same argument. For fractures, we are particularly concerned that reduced transfers and higher readmits may reflect an untoward quality pattern. Overall, however, it appears that in all tracers large LOS reductions have not prompted

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED PER CAPITA ANALYSIS

Table 7.1

Summary of Significant Trends in Episode Use Patterns[1]

	Patient Category									
	Stroke			Pneumonia		Hernia			Hips	
Measure	DRG005	DRG014	DRG015	DRG79/80	DRG89/90	Comp	Bilat	Unilat	Osteo	Fract
LOS	-	-	-	-	-	-	-	-	-	-
% Using ICCU		+	-	+						
% Transferred	-						-			-
% Readmitted in 7 days		+						+		+
Ancil./Total Charges	+	+	+		+	+	+	+	+	+
Total Reimbursements				+		-	-			+
-Percent Part B	-	-	-	-	-	-	-	-	-	-
-Percent MD	-	-	-	-	-	-	-	-	-	-
-Ratio of MD Inpatient to Ambulatory		-	-		-					-
-Percent Post		+			+		+	+	+	
-Percent Post (exc. hosp.)			+			+			+	
-Total Hospital Reimbursements		+	-			-			+	+
HHA Admits Post 7	+	+		+	+				+	+
SNF Admits Post 7		+							+	+
HHA Visits Post 14	+	+	+		+			+	+	+
Percent Using DME		+		+	+	+			+	+
Number of OPD Visits			-							
Number of ER Visits			+						-	+
Percent Rural Beneficiaries in Urban			-	+	+	+	-			

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[1] Signs reflect the direction of significant mean differences between 1981-83 and 1984-86 using a criterion of $p \leq 0.10$.

dumping (which might be seen as more transfers), nor do we see for 7 of 10 tracers an indication of higher readmission rates.

Total episode reimbursement levels are generally not increasing faster or slower than DRI's Medical Care Price Index. Lung infections and hip fracture are exceeding that pace of inflation--and the two more complicated hernia procedures are inflating at a slower pace. Part of the explanation lies in the importance of MD payments represented in each tracer, and the effects of the fee freeze. For the two hernia procedures the fraction of episode costs for MDs approaches 30%--the highest of all of our tracers. For the other two, DRG 79/80 and DRG 209 (fractures), the MD portions are 7% and 16%, respectively. As we see from Table 7.1, Part B and MD payments have not kept pace with inflation, tending to offset influences on episode spending from more post stay care and higher (than inflation) inpatient payments in 3 of the tracers. Overall, we do see some compression of the distribution of total episode payments over time, which is no doubt caused by PPS effects on hospital payments and the fee freeze.

Table 7.2 shows the two definitions of the post period episode cost. The importance of post period payments in the episode varies across tracers and has increased over time, although not as alarmingly as expected. It is obvious that the inclusion of rehospitalizations and readmissions into the post period results in much higher percentages of post period costs for the stroke and pneumonia tracers than for the hip repair and hernia tracers. Moreover, the increase between pre-PPS and post-PPS is statistically significant for five out of ten tracers compared to three out of ten when subsequent hospital stays are included in the measure of post period episode costs.

The Part B and physician payment findings are interesting. Hospital payments under PPS have risen more often than fallen for our ten tracers. Pressures to increase use of pre and post stay services are evident in the utilization rates. And, it appears that physician office use rates are up as well. Consequently, it appears that the only reason why episode payments are not increasing in the face of all this substitution (for days in the hospital) is the pressure on physician fees. Absent that fee freeze, which dominates Part B spending and the shares of Part B spending on Table 7.1, we could have expected to see more than general medical inflation in the Medicare episode reimbursement levels. That is not withstanding trends in Medicare payments per beneficiary or total hospital payments. Obviously, there are fewer beneficiaries being admitted; that fact, along with the fee freeze, has allowed spending to appear better than the cost per episode of care when a hospital is involved.

Post hospital care use rates are observed to be significantly higher in many of the tracer categories. The most affected group appears to be hip surgeries where SNF

Table 7.2

Episode Reimbursements for 1986
(1981 dollars)

Tracer Group	Total (30-30)	Percent Pre	Percent Post	Percent Post excl. Hosp.
DRG 015 (TIA)	$2991	5.4%	16.6%	4.4%*
DRG 005	5974	3.8	6.2	1.7
DRG 014 (Stroke)	4339	2.6+	16.2*	7.2
DRG 209 (Osteo)	7348	1.4	5.9*	3.5*
DRG 209 (Fx)	7306*	1.7	11.3	7.6
DRG 79,80	5340*	3.5	9.7	4.1
DRG 89,90	3087	3.5	10.8*	4.6
DRG (Comp.)	2158+	3.3*	7.1	3.5*
DRG (Bil.)	1728+	2.7	6.0*	2.8
DRG (Unil.)	1713	3.4	5.3*	2.6

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* denotes significant 81-83 and 84-86 increase ($p \leq 0.10$).

+ denotes significant 81-83 and 84-86 decrease ($p \leq 0.10$).

and HHA use rates are largest. But only in osteoarthrosis surgeries do we see a significant increase in the share of episode reimbursements going to post stay services. HHA access (within 7 days of discharge) is higher in 6 of the 10 tracers (and nearly significant in several others). HHA visit intensity is also higher in 7 of the 10 tracers during the first two weeks of post discharge. The major change in HHA use patterns appears to be a nearly universal increase in the likelihood of HHA admission within seven days of discharge.

SNF use rates are up only for stroke (DRG 014) and hip surgeries. But DME use is higher in six of the 10 tracers.

There are not strong indications that OPD or ER settings are being substituted for inpatient care. OPD visits per episode are never higher, and once lower (TIAs). ER visits are up for episodes of TIA and hip fracture, but down for osteoarthrosis hips. It is not clear what, if anything, this all means, other than visit volumes in OPDs are not higher.

We were concerned about shifting the mix of episodes across hospitals, particularly rural (non-SMSA) beneficiaries choosing urban or rural hospitals. We do find evidence that higher fractions of rural residents seek care for the two pneumonia groups and complicated hernias in urban hospitals. Lower fractions of rural beneficiaries are using urban hospitals for TIAs and bilateral hernias. Most of the insignificant cases are also lower. These changes suggest that, except pneumonias, there is an attempt to not refer cases, or to become more self-reliant. Pneumonias are difficult to explain. Possibly some dumping is occurring; admission rates are rising for these cases and our case studies suggest that PROs are pressuring many smaller rural hospitals to study the "problem" of large numbers of pneumonia admissions.

The pattern of change is more pronounced for some tracers than others. Hips and stroke are more pronounced than hernias, particularly the simpler procedures. One might suspect that severity might be positively associated with more extensive substitution patterns (bigger LOS, larger cuts, more substitution). But TIAs would be the exception to that rule; if the TIA changes are not due to coding shifts and falling severity.

In general and in the broadest terms, we can say that between 1981 and 1986 the practice trends for these tracers have been:

- marked cuts in LOS, about 25% of which is due to pre surgery day reductions for surgical tracers;

- no evidence of potentially untoward incentives to reduce intensity; access to ICCU or other ancillary services has not been reduced;

- substantially less indication of changes in the pre admission period relative to the ummediate post period;

- large and pervasive increases in the likelihood of getting SNF, DME, and HHA services; for the latter the increase in HHA admission rates is almost solely due to admissions in the week following discharge--providing strong evidence of substitution against LOS reductions;

- fewer patients are being transferred; coupled with lower LOS, this may be related to higher readmission rates;[1] PPS may be encouraging hospitals and physicians to take more readmission risks;

- physicians are providing fewer services in the hospital, and more in the office;

- practice pattern changes have not altered the fundamental structure of reimbursement; episode reimbursements are still dominated by payments made while an inpatient (over 90%), and costs to Medicare are increasing by about the same rate as the DRI Medicare care price index; the only reasons Medicare is not paying much more per episode is the physician fee freeze.

Chernoff Faces. Clearly, aspects of the episode practice pattern have changed, and others not. Aside from total reimbursements, there is no scalar measure available to capture all of the dimensions of the practice pattern; hence no ready test is possible--nor is any easy visualization possible of this multi-dimensional thing called a practice pattern.

A technique has been suggested and developed by Chernoff (1973) that graphically represents multi-attribute concepts as human faces. Chernoff faces is a recently developed technique used to display multidimensional data. In using this technique, each multivariate observation is represented as a human face, with each dimension of the data corresponding to a distinct facial feature. The justification for the use of faces to display multidimensional data can be shown by noting that the mind is accustomed to recognizing subtle differences in facial features, and that detecting differences among multivariate observations can be greately facilitated when expressed in the form of faces. Chernoff face drawing routines can be found in several statistical software package, and the faces created for this report were generated by the Bell Laboratories version of the statistical package S.

---

[1] There is no evidence that mortality has changed.

The following table describes how each of the variables in the data set are seen in the faces. For each variable, the Chernoff face routine scales the data to the interval from 0 to 1, and then draws the corresponding facial features for each face in relative magnitude to its scaled value. For the purpose of this study, the faces show the differences between the 1981 and 1986 sample means for the different groupings.

	Feature	Practice Pattern Measure
1.	Area of face	LOS
2.	Shape of face	percent transferred
3.	Length of nose	number of SNF days post 30-day period
4.	Location of mouth	number of HHA visits post 30 days
5.	Curve of smile	OPD and ER visits pre 30-day period
6.	Width of mouth	MD inpatient reimbursement
7.	Location of eyes	physician plus OPD reimbursement pre 30 to post 30
8.	Separation of eyes	percent receiving SNF or HHA care in 7 days post discharge
9.	Angle of eyes	readmit and rehospitalization rate post 30 days
10.	Shape of eyes	DME reimbursement post 30
11.	Width of eyes	ratio of ancillary/total charges

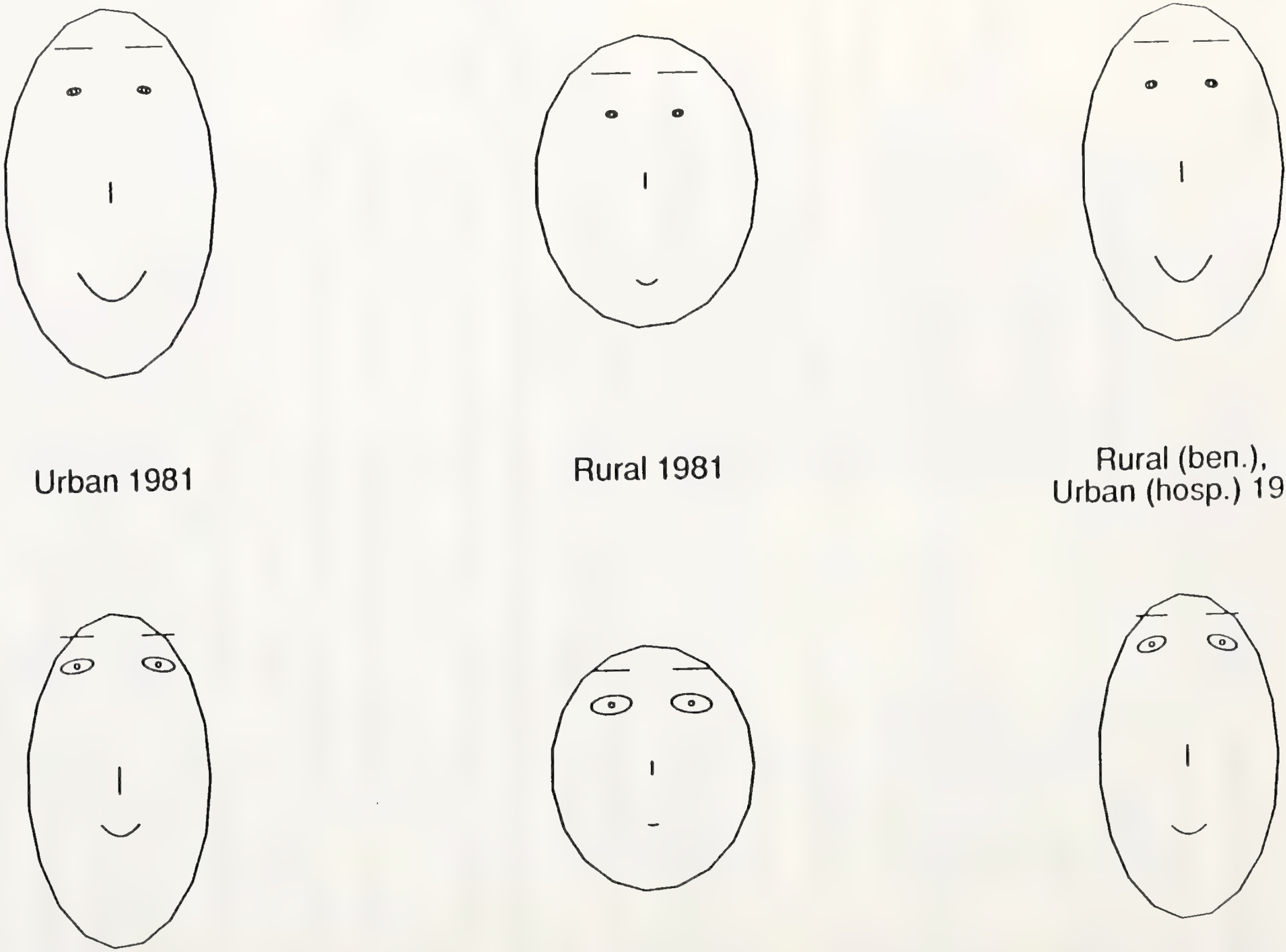
There is no statistical method of comparison for the faces we describe below. This is only a qualitative gesture attempting to describe whether and what degree practice patterns for 1981 and 1986 are different. The author accepts no responsibility for any inadvertant similarities there may be in these images to real particular individuals.

Figure 7.1 represents a tracer category, with faces representing discharges to urban hospitals, rural hospitals and rural persons discharged from urban hospitals. Faces for each group for 1981 and 1986 are shown.

For hernias, we see more differences over time than across groups. There are distinctive features for the group of rural persons going to urban hospitals; in 1981 they resemble other urban discharges except they have fewer OPD and ER visits. The difference is more pronounced in 1986, though they have more physician office care (height or location of eyes). Over time, the faces show more similarity for all three groups in terms of age features, and face size (LOS). Differences still exist in the width of mouth (MD inpatient reimbursement), location of mouth (HHA visits) and location of eyes (ambulatory reimbursement).

For simple pneumonia, we also see substantial urban-rural differences, with the vulnerable group resembling the other discharges from urban hospitals. Differences between groups in face shape (transfer rates) do not dissipate over time. But there are marked differences in faces over time. As with hernias, the width of mouth and

Figure 7.1a
Pneumonia - Simple



Urban 1981

Rural 1981

Rural (ben.),
Urban (hosp.) 1981

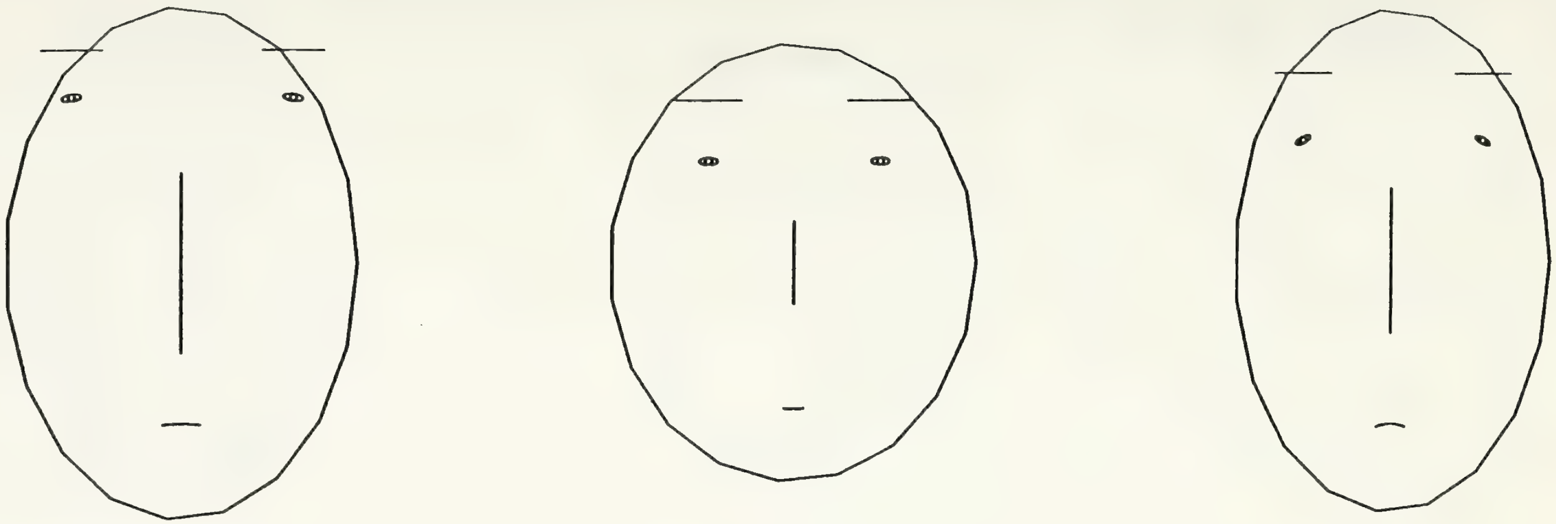
Urban 1986

Rural 1986

Rural (ben.),
Urban (hosp.) 1986

Figure 7.1b

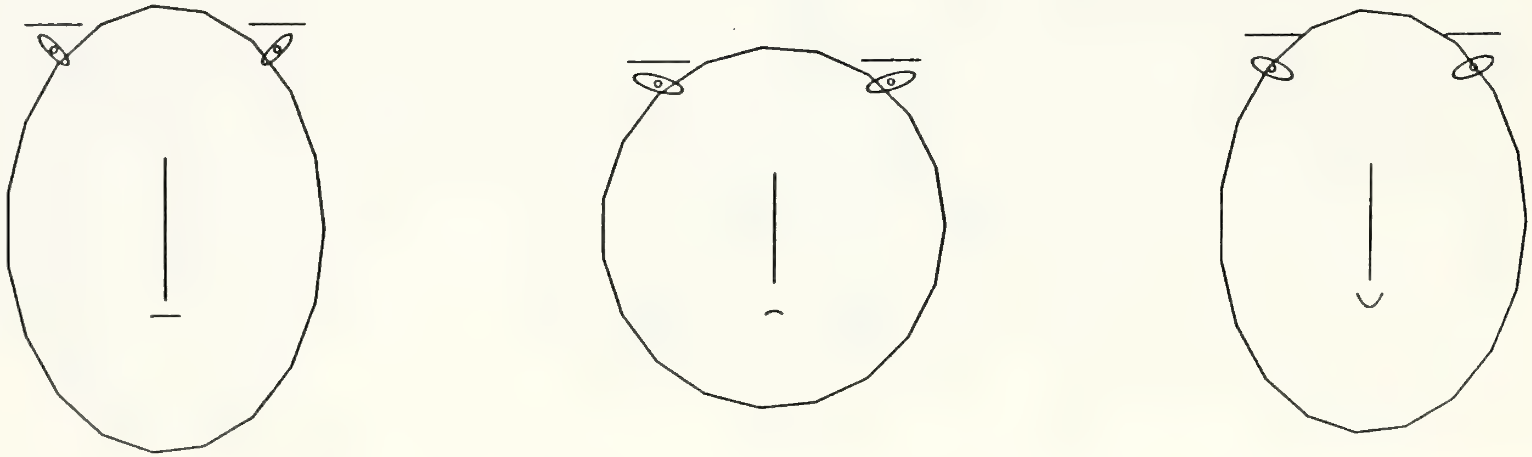
Stroke - DRG014



Urban 1981

Rural 1981

Rural (ben.),
Urban (hosp.) 1981



Urban 1986

Rural 1986

Rural (ben.),
Urban (hosp.) 1986

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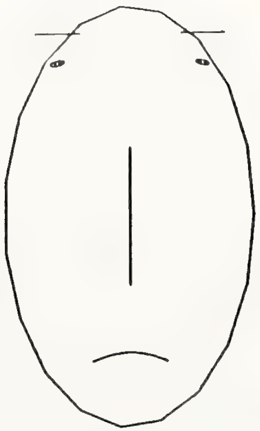
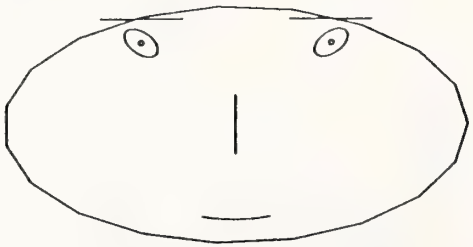
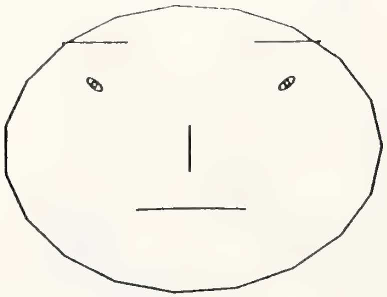
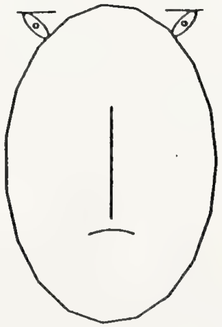
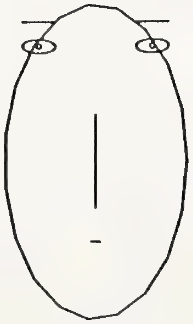
Figure 7.1c
Hips - Fractures


Urban 1981


Rural 1981


Rural (ben.),
Urban (hosp.) 1981


Urban 1986


Rural 1986

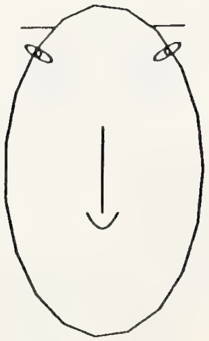
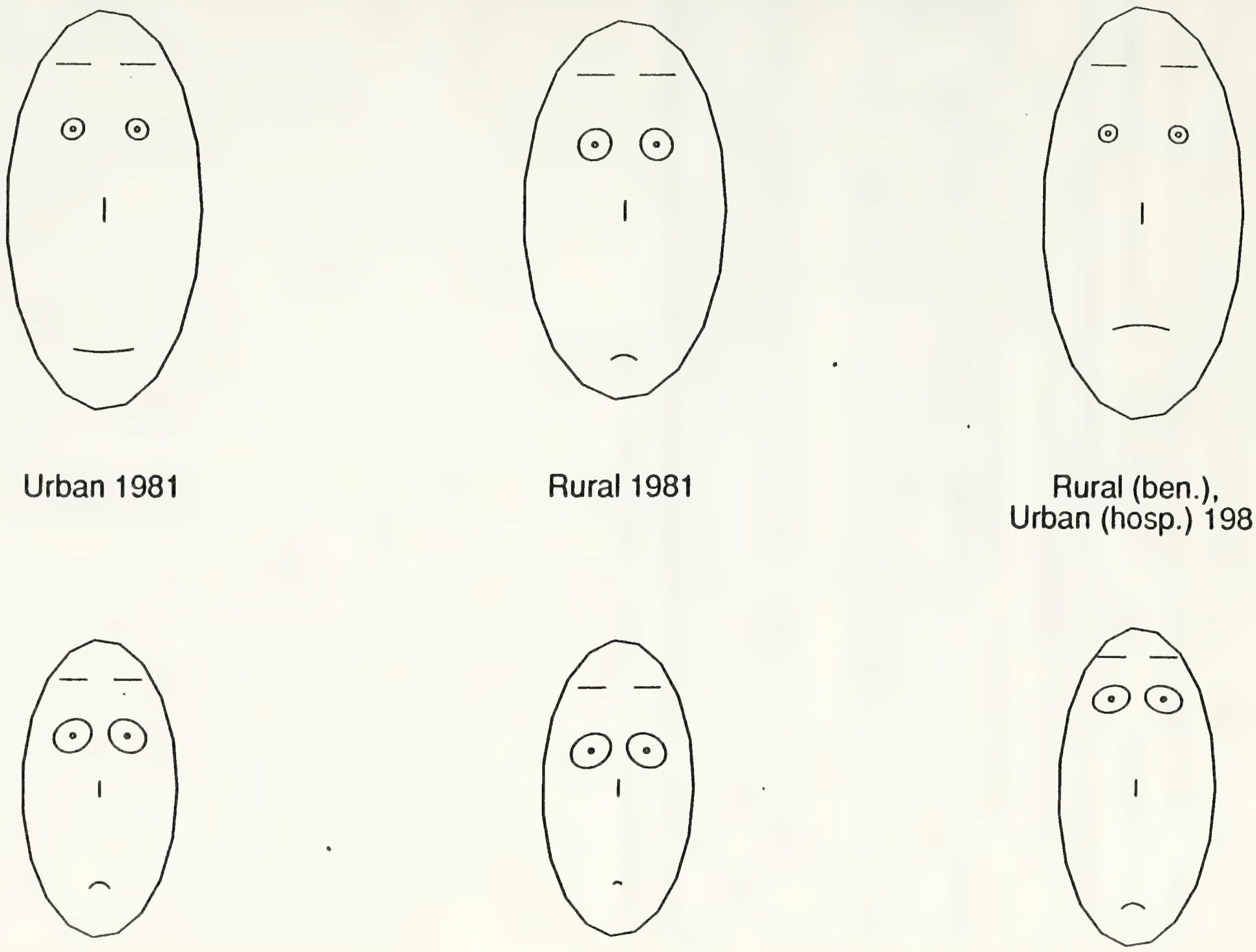

Rural (ben.),
Urban (hosp.) 1986

Figure 7.1d

Hernia - Unilateral



Urban 1981

Rural 1981

Rural (ben.),
Urban (hosp.) 1981

Urban 1986

Rural 1986

Rural (ben.),
Urban (hosp.) 1986

elevention and shapes of eyes have changed; the height of eyes and width of mouth reflect marked changes in MD reimbursement due to the fee freeze (lower inpatient MD payments and width of mouth and higher MD and OPD payments and the height of eyes); the shape of eyes reflects DME use; and, the separation of eyes reflects post hospital SNF and HHA use rate in 7 days.

For strokes, there is a difference in rural beneficiary practice patterns which reflects, as in other tracers, differences in the shape of the face (transfer rates). Over time, the big changes shared across groups are the increase in MD payments for office and OPD care (location of eyes) and the increase in 7 day SNF or HHA access rates (separation of eyes).

Hip fractures show the most interesting and substantial episodic practice pattern changes; there is little similarity in faces across groups and substantial changes over time. The massive cross group differences reflect transfer rates (face shape) and pre stay OPD and ER use rates (curve of mouth). Obviously, face shape (transfer rates) is much more similar across groups in the post period.

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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--

Effects of PPS on Per Capita Medicare Utilization: 1981-1986

Working Paper

Robert J. Schmitz

February 23, 1989

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Health Care Financing Administration
Office of Research
Baltimore, MD 21207

An Equal Opportunity Employer

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EXECUTIVE SUMMARY

Since the inception of the Prospective Payment System in late 1983, the effects of the new payment method on levels of hospital and posthospital medical care rendered to Medicare beneficiaries have been a matter of conjecture and debate. Resolution of the issue has proved elusive, primarily because there is no clear means of establishing the levels of care that would have prevailed had PPS not been implemented. In this paper, indicator variables for time (year) and location (waivered and nonwaivered states) are used separately and in conjunction with one another to construct eight alternative measures of PPS and TEFRA-cum-PPS on dimensions of hospital, HHA and SNF utilization covered by Part A of Medicare. The methodology employed in constructing the estimates is a variant of the interrupted time-series approach advocated by the General Accounting Office (1986) in a report to the U.S. Senate Special Committee on Aging. The alternative measures are:

- A simple pre-post (before-and-after) comparison of utilization rates in 1984 (and in 1983/84) with utilization in the previous year;
- A comparison of changes in utilization in 1984 (and in 1983/84) with changes in utilization in 1982;
- A double-difference measure comparing changes in utilization in nonwaivered states in 1984 (and in 1983/84) with changes in utilization over the same time period in waivered states; and
- A comparison of changes in utilization in 1984 (and in 1983/84) relative to changes in utilization in 1982 in nonwaivered as opposed to waivered states.

Each of the four types of measures is computed using the year effects for 1984 as an indicator of PPS effects and also using one-half of the sum of the year effects for 1983 and 1984 as indicating joint TEFRA-PPS effects. Which of these estimators is correct depends on the unknown configuration of non-PPS effects operating in waivered and nonwaivered states in various periods. There is no guarantee that any of the estimators is correct. The aim in constructing these measures is to bound the true PPS effect somewhere within the range of the estimates. All comparisons are performed on the basis of OLS and fixed-effects regression models estimated on aggregates of quarterly Medicare utilization in 349 geographic areas for the years 1981 through 1986.

Principal results are summarized below:

Hospital Admissions. Except for seasonal variation, hospital admissions have declined monotonically since the first quarter of 1983 in both waivered and nonwaivered states. Some of this decline is almost surely the result of PPS and TEFRA. The range of estimates of PPS effect is from zero to 0.02 fewer admissions per enrollee per quarter. Because admissions declined by similar amounts in waivered and nonwaivered states in 1983 and 1984, the double-difference estimates of PPS effects are small and statistically insignificant, while the pre-post estimates are larger and significant. These estimates do not distinguish the effects of prospective payment itself from the effect of PRO review of admissions.

Hospital Length of Stay. PPS reduced length of stay for Medicare beneficiaries by three-tenths to nine-tenths of a day. However, length of stay rose somewhat in PPS states in 1985 and 1986, both absolutely and relative to waivered states, suggesting that the long-run PPS effect may be somewhat smaller than this.

Hospital Days Per Enrollee. Quarterly hospital days are estimated to have fallen by as much as zero to one-quarter of a day per enrollee as a result of PPS. Pre-post measures are greater than double-difference measures in absolute value, indicating that days per enrollee were declining nearly as fast over the period in waivered as in nonwaivered states.

Rehospitalizations Per Hospital Admission. Rehospitalizations were the sole dimension of health care for which statistically significant and contradictory results were obtained. Pre-post estimates indicate that PPS produced a decline of between 50 and 136 rehospitalizations per 10,000 admissions. The double-difference estimates suggested an increase of as much as 47 rehospitalizations per 10,000 admissions. On this basis, we have refrained from concluding that PPS has had any systematic effect on the probability of rehospitalization.

Home Health Care. PPS is estimated to have increased HHA visits per enrollee by 0.03 to 0.06 visits per quarter, HHA visits in the 30-day post-hospital period by 0.14 to 0.3 visits per admission, and to have raised the fraction of hospital stays followed by HHA care by as much as .02. These PPS effects on the volume of home health care may have accounted for as much as 40 percent of the observed increase in HHA care between 1981 and 1984.

SNF Care. Pre-post estimates show uniformly significant increases in SNF care as a result of PPS. The double-difference estimates show uniformly insignificant changes in SNF care attributed to PPS. Closer examination of the regression results suggests that while PPS has probably resulted in sharply increased use of SNF care in rural areas (perhaps as much as 50 percent), there is little evidence of any continuing effect of PPS on SNF care in urban areas.

Part A Expenditures. On the basis of double-difference measures, PPS is estimated to have produced an increase in hospital and HHA payments per enrollee. Part A payments per enrollee are estimated to have risen by between $12 and $39 per quarter. These figures may be an artifact of non-synchronized rate-setting policies in the waivered states as opposed to HCFA or they may genuinely reflect the greater ability of waivered states to control increases in payment rates. Because the double-difference estimates showed no effect of PPS on hospital admission rates, there is no reason to believe that PPS-induced changes in inpatient utilization account for the differences in hospital expenditure. Estimates of the PPS effect on HHA payments ranged from increases of $1.22 to $2.28 per enrollee. PPS effects on SNF payments per enrollee were small (about $0.25) and statistically insignificant.

Other Results. Growth in HMO enrollment per 100 population in an area is estimated to reduce hospital length of stay, days per enrollee and Part A expenditures per enrollee by statistically significant amounts. Since few Medicare enrollees were members of HMOs in this period, this effect is either a mask for some other left-out correlate or reflects HMO effects on general patterns of practice in a community. For reasons that are unexplained, and deserving of future research, hospital utilization and Part A payments per enrollee appear to decline as the ratio of Medicare enrollees to the population increases. Increases in physicians per capita and hospital beds per capita both tend to raise Part A payments per enrollee. This relationship is understated by standard OLS methods. Regional variation in payments per enrollee is substantial (some 25 to 30 dollars higher in the northeast than in mountain and western states) and is much more pronounced in urban than in rural areas.

I. INTRODUCTION

In terms of its role in public discussion and debate, the provision and financing of health care is to the nineteen eighties what energy supply was to the nineteen seventies. The debate has been fueled by a steady expansion of health care expenditures as a percentage of GNP, prompting a slow realization that it is no more possible for consumers to have unlimited health care than it is for consumers to have unlimited quantities of any other service or consumer good. Even during the seventies, some were questioning whether the current levels of health care and health insurance were "too high." The expansion of health expenditures was accompanied, and probably partially caused by, a continuing increase in the share of health care expenditures borne by third parties (especially the federal government and private health insurers). The share of health expenditures borne directly by patients has fallen from 31.2 percent in 1974 to 24.6 percent in 1984.

Since 1976, the federal government has paid between 28 and 30 percent of all health care expenditures; private health insurers have paid some 27 percent. Should expenditures continue to grow more rapidly than GNP, concommitant increases in tax rates and insurance premiums would be almost inevitable. Numerous methods of controlling the rise in health care cost have been introduced or expanded. Health maintenance organizations (HMOs), with their strong gatekeeper arrangements to prevent unmonitored use of specialists and high-cost providers, have grown vigorously during the eighties. Mandatory second opinion programs for elective surgery are now common. Many companies have introduced "wellness programs" in the hope that employees may be induced to modify their behavior (by improving their diet, exercising, quitting smoking) in ways likely to reduce their use of medical care.

Of all the methods designed to control expenditures, the introduction, in late 1983, of the Prospective Payment System (PPS) for Medicare-covered hospital stays, has been the most significant by far. In place of the previous system of cost reimbursment, PPS constituted a set of fixed, known prices for hospital stays of each type. By design, PPS would mimic the operation of a competitive marketplace for hospital care in which competition and the desire to earn profit and avoid loss encouraged hospitals to provide services efficiently. By setting the appropriate prospective rate, the government could obtain hospital care for Medicare enrollees at the minimum attainable cost.

Under PPS, hospitals receive a payment for hospital care rendered to Medicare beneficiaries that is unrelated to incurred cost for the care. With some exceptions for "outlier" stays, the difference between payment and cost must be absorbed by the hospi-

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tal as a loss or may be retained as a profit. Most analysts expected that PPS would increase hospital admissions, reduce the average length of a hospital stay, and would lead to a substitution of HHA, SNF and outpatient Part B care for hospital care. "Sicker and quicker" soon became a catchphrase describing the nature of patient discharges anticipated after PPS.

The decision to admit or discharge a patient is made by the patient's physician, not the hospital, so the link between PPS and admissions or length of stay cannot be direct. Rather, PPS creates incentives for hospitals to change the opportunity costs facing physicians that have admitting privileges in order to optimize their performance under PPS. A proper counterfactual expression for the effect of PPS might actually be that admissions would increase and length of stay would decrease to a greater extent than would have occurred in the absence of PPS. The failure of admissions to rise after the implementation of PPS then becomes somewhat easier to understand, especially since admissions had generally begun to decline well before the introduction of PPS.

This paper examines the utilization of and payment for medical care received under Part A of Medicare from 1981 to 1986. (Hospice care is excluded from the analysis.) It focuses on changes in the quantities and dimensions of care and on the effects of PPS on the amounts and types of care received over the period. The effects are difficult to discern and cannot be established unambiguously due to inherent limitations in the data. The approach taken in this paper is therefore to develop a set of alternative estimates of the influence of PPS on the per capita utilization of inpatient and post-hospital care by Medicare enrollees. Each of the estimators is in turn derived from the estimated coefficients of a generic model of utilization described in Chapters IV and V. This model is a variant of the interrupted time-series design (adapted to suit the needs of population-level data) recommended in a recent report by the General Accounting Office (1986). The eight distinct estimators are intended to form bounds within which true PPS effects can confidently be expected to lie.

II. DATA

All measures of Medicare Part A utilization used in this study are drawn from the Abt Associates Twenty Percent BEAA-Quarter Per Capita Analytic File. BEAAs (Bureau of Economic Analysis Areas) were developed by the Bureau of Economic Analysis for regional economic studies. These geographic areas of commerce consist of an MSA (Metropolitan Statistical Area) or other urban center and surrounding counties that are economically linked to the center. These areas cover the entire United States. The BEAA Economic Areas were modified somewhat for this study in order to insure that waivered and nonwaivered areas were not contained in a single area. Each area that contained both urban and rural parts also was divided into its rural and urban county components.[1] The resulting file contains utilization for each of the 349 areas.

The Analytic File contains quarterly summaries of Medicare Part A utilization (e.g., inpatient, SNF, and HHA) for all beneficiaries in the standard 20 percent sample. The summaries are based on hospital and SNF stay records and HHA bill records for the period 1981-1986. All measures appearing in the file, including reimbursements, admissions, covered days, and visits are aggregated from the beneficiary claim level to the BEAA Economic Area level for each quarter from 1981 Quarter I to 1986 Quarter IV (24 quarters) based on the SSA state and county codes and the admission or from-dates present on the stay and bill records.[2] Medicare enrollment totals for each area by year also appear on the file, allowing utilization to be computed on a per-beneficiary basis.

In addition to strict aggregates, such as inpatient reimbursements, hospital admissions, or HHA visits, linked measures of utilization also appear in the file. These measures are aggregates of hospital, SNF, and HHA utilization that occurred within a fixed span of time, usually 30 days, of a beneficiary's hospital stay. Specifically, these measures relate inpatient hospital stays for a given beneficiary to other inpatient stays, to SNF stays, and to HHA bills for that same beneficiary.

All measures were inflated by a factor of five to represent total Part A utilization during the period. Readers should be aware that data were aggregated and appear in the file only if the appropriate claim appeared in the relevant HCFA sample.

---

[1] The urban-rural distinction was determined by the location of a given county within or not within an SMSA in 1983.

[2] Because of problems with missing data, claims from Alaska, Hawaii, and Puerto Rico were not aggregated, and these areas do not appear on the file.

Clusters of missing claims are known to exist for particular areas at particular times resulting from disputes with intermediaries or from simple loss. Many of the quantities calculated on a "per enrollee" basis are therefore likely to be underestimated. For example, Part A reimbursement per enrollee as computed from this file is $1329, some ten percent lower than the $1521 cited by the U.S. General Accounting Office (1988). The consequences of such missing data for the empirical work reported here are difficult to assess and have not yet been explored.

III. USE OF MEDICARE PART A: 1981 - 1986

Payment for hospital care has accounted for nearly all of Part A expenditures throughout the history of the Medicare program. This predominance can be seen in Figure 1 which displays the three components of Part A reimbursement per enrollee from 1981 to 1986. Part A expenditures per enrollee rose from $216 in the first quarter of 1981 to $360 in the third quarter of 1986, an increase of 67 percent over 5½ years. Current dollar GNP per capita rose just 32 percent over the same period. The marked seasonality of hospital expenditures (and so of Part A expenditures as well) is clearly visible in the figure; seasonal peaks typically appear in the first quarter of the year. No seasonality is apparent for HHA or SNF care.

The split vertical scale of the graph produces a visual overemphasis of the importance of HHA and SNF reimbursements in Part A. Even though HHA reimbursement per enrollee has more than doubled from about six dollars to over fourteen dollars per enrollee over the period, the share of hospital payments in total Part A expenditures has fallen only slightly, from 95.7 to 94.6 percent. SNF reimbursements increased by only about 50 cents per enrollee over the period.

Figures 2 and 3 present the same components of Part A expenditures separately for rural and urban enrollees. Throughout the period, hospital reimbursements per enrollee grew at about the same rate in the two areas, with rural levels remaining about 80 percent of those in urban areas. For SNF and HHA care, the pattern is much different. While both SNF and HHA reimbursements per enrollee were higher in urban than in rural areas, rates of growth were far greater in rural areas. SNF reimbursement per urban enrollee rose by only about 10 cents between 1981 and 1986 (from $4.20 to $4.31); for rural enrollees, the increase was over 60 percent, from $2.22 to $3.60. HHA reimbursement per enrollee increased by about 220 percent for urban areas and about 290 percent for rural areas during the same period.

Four states (Maryland, Massachusetts, New York, and New Jersey) were granted waivers from PPS payment rules and were allowed to continue under previously established state prospective reimbursement rules. Expenditures per enrollee for states that entered PPS in FY 1984 are compared with those in the four waivered states in Figures 4 and 5. Hospital expenditures are generally higher in the waivered states, at least partly because of their greater urbanicity. They also rose somewhat more rapidly in the waivered states, 55 percent from 1981 QI to 1986 QIII, compared to 49 percent over the same period for nonwaivered states.

SNF reimbursement per enrollee actually declined in waivered states from $3.54 in the first quarter of 1981 to $2.81 in the third quarter of 1986. In the nonwaivered states, SNF reimbursement rose from $3.63 to $4.34 per enrollee over the same period. Home health reimbursements, while lower in nonwaivered states at the beginning of the period, rose more rapidly there, so that by the third quarter of 1986, HHA reimbursement per enrollee in nonwaivered states was $14.23 compared to $13.40 for waivered states.

These comparisons of expenditure patterns in waivered and nonwaivered states are consistent with the common predictions that PPS would lead to reductions in the length of hospital stays and increased reliance on home health and SNF care in general, and most particularly to provide services that previously had been furnished in the last day or two of a hospital stay. This explanation is difficult to confirm as will be seen later.

For each of the three components of care provided under Part A, expenditure per enrollee can be expressed as the product of several dimensions of service, for example, expenditure per unit of care, units of care per admission to care, and admissions to care per enrollee. By computing rates of change for each of these dimensions, units of measurement are eliminated and relative movements of all dimensions can be plotted on a single graph. Figures 6 through 10 display the mean rates of change in hospital expenditure per enrollee for the entire U.S. and by urban-rural and waiver-nonwaiver status of the study areas. The change in hospital expenditure per enrollee is represented in the following way:

Hospital Expenditure per Enrollee

$$= \begin{array}{l}\text{Expenditure}\\ \text{per Hospital}\\ \text{Day}\end{array} \times \begin{array}{l}\text{Hospital}\\ \text{Days per}\\ \text{Admission}\end{array} \times \begin{array}{l}\text{Admissions per}\\ \text{Enrollee with}\\ \text{any admissions}\end{array} \times \begin{array}{l}\text{Proportion}\\ \text{of enrollees}\\ \text{with admits}\end{array}$$

The figures display expenditure per enrollee (represented by the heavy line) together with each of the four dimensions above. All quantities are expressed as ratios to their 1981 QI value to enable the use of a common vertical scale. For this reason the figures can be used to infer rates of change only. Levels (that is absolute amounts) of care cannot be seen or compared in the figures. Note that the vertical scale is logarithmic so that the halving of any quantity is represented by the same distance as a doubling of that quantity.

The general decline in hospital length of stay and in admissions has slowed the rate of growth in hospital expenditures. Payment per hospital day and, to a much smaller extent, admissions per enrollee having any admissions in the quarter (a crude measure of quarterly readmissions) have accounted for the increase in hospital expenditures per enrollee. The rise in reimbursement per day and the decline in admissions (proportion of enrollees with an admission) have been sharper in rural than in urban areas, as can be seen in Figures 7 and 8. The figures also reveal that readmissions (admissions per enrollee having at least one admission) increased steadily in urban areas, but stopped rising by mid-1983 in rural areas.

A comparison of waivered and nonwaivered states (Figures 9 and 10) clearly shows a more pronounced decline in the proportion of enrollees with an admission in nonwaivered states. The reduction in average length of stay, while nearly identical in the two areas, occurred gradually in the waivered states but much more abruptly in the early-'83 to mid-'84 period in the nonwaivered states.

Trends in SNF reimbursement per enrollee are displayed in Figures 11 through 15. This reimbursement is expressed as

$$\begin{array}{c}\text{SNF Reimbursement}\\ \text{per}\\ \text{Enrollee}\end{array} = \begin{array}{c}\text{Reimbursement}\\ \text{per}\\ \text{SNF Day}\end{array} \; \text{X} \; \begin{array}{c}\text{Days per}\\ \text{SNF}\\ \text{Admission}\end{array} \; \text{X} \; \begin{array}{c}\text{SNF Admissions}\\ \text{per}\\ \text{Enrollee}\end{array}$$

Overall, SNF expenditures per enrollee have changed little since 1982. The patterns for urban and rural areas, however, are quite different. While urban areas exhibit mild declines in both admissions per enrollee and length of stay, rural areas show a sharp decline in length of stay dating from mid-1982, together with a sharp increase in admissions starting at about the same time. The same pattern is present, though less stark, in a comparison of waivered and nonwaivered states.

Figures 16 through 20 show the change in HHA expenditures per enrollee represented as:

$$\begin{array}{c}\text{HHA Reimbursement}\\ \text{per}\\ \text{Enrollee}\end{array} = \begin{array}{c}\text{Reimbursement}\\ \text{per}\\ \text{Visit}\end{array} \; \text{X} \; \begin{array}{c}\text{Visits}\\ \text{per}\\ \text{Enrollee}\end{array}$$

The apparent decline in utilization in the second quarter of 1981 is almost certainly the result of undercorrection for missing HHA data in the original HCFA files.

Urban-rural differences in HHA utilization have already been discussed. A striking feature of Figures 19 and 20 is the much more rapid rate of growth of home health utilization (visits per enrollee) in the nonwaivered states, especially after the middle of 1983.

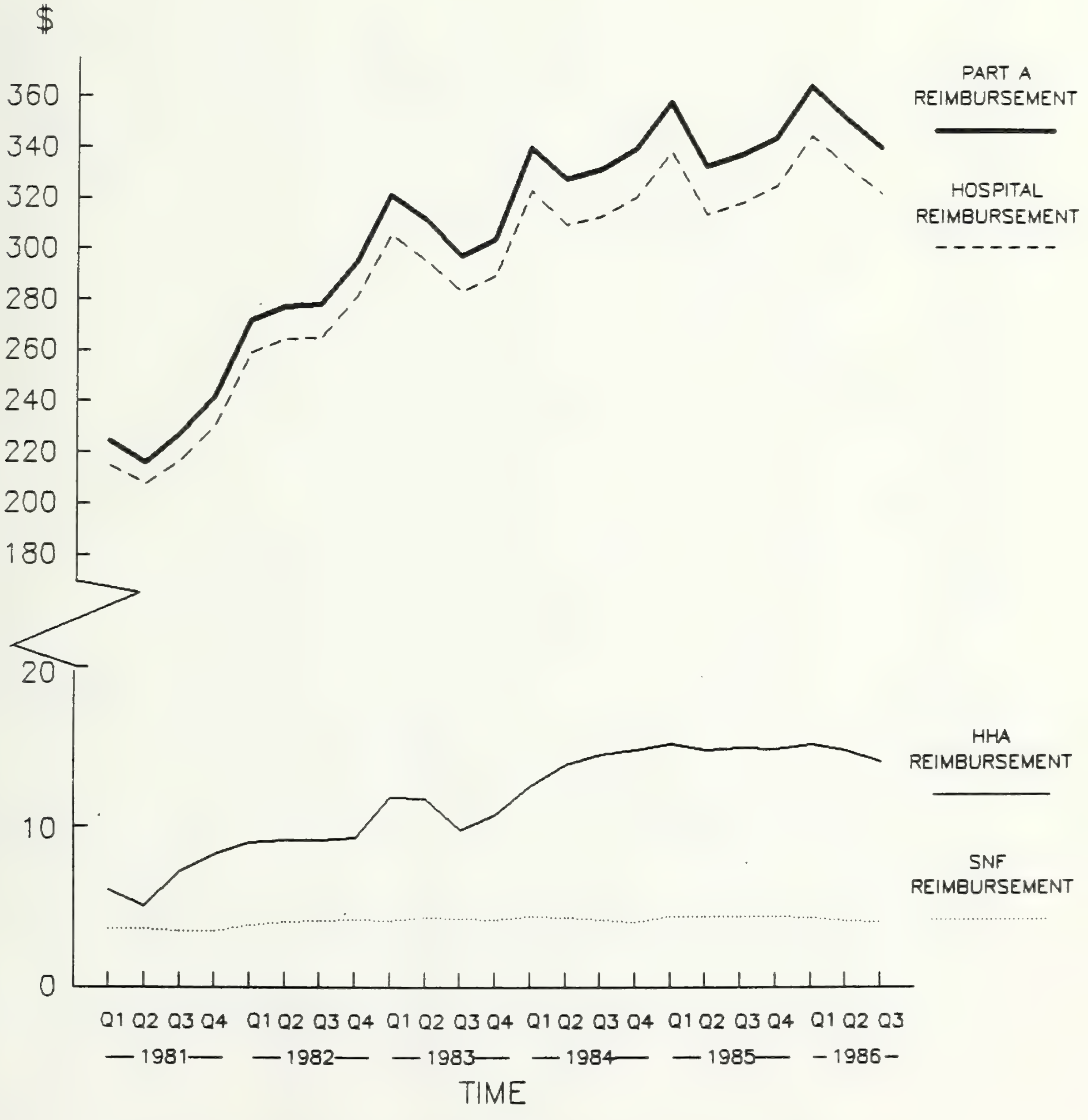
A Note on Deflation of Dollar Values

None of the dollar-denominated variables in Figures 1 through 20 or anywhere in this report is adjusted for inflation. Some method of price adjustment is ordinarily undertaken since changes in prices and expenditures are more meaningful when compared to the underlying rate of change of prices in the economy as a whole. The easiest method is simply to divide all dollar values reported in a particular year by the Consumer Price Index or the GNP Deflator for that year. In the health care sector, deflation of this sort is a thorny issue since the units by which health and medical care are measured are fairly arbitrary and not especially informative. In the figures displayed above, hospital and SNF care were measured by the day and HHA care was measured in visits. The nature and intensity of services delivered to a patient during a day or visit vary across patients, due to differences in their own conditions, extent of comorbidities, underlying levels of health, and also in family structure and living arrangements. They will also vary across providers and regions due to differences in patterns of practice, as may be seen, for example, in the well-documented regional variations in surgery rates. Finally, they will vary over time as technological change produces alterations in care that were not possible at earlier times. No agreed-upon method of deflation has yet been devised that accounts for all of these differences.

A further difficulty that arises in attempts to adjust for price inflation is that legislative changes may bring about changes in the mean patient mix (only incompletely captured by casemix indices) that can lead the mean expenditure per hospital day, say, to appear to rise even in the absence of inflation. Morrisey et. al. (1984) emphasize the explicit incentives created by PPS to unbundle services, such as recuperative time, that were formerly part of a hospital stay, moving them to a nonhospital setting. As these relatively low cost days are moved out of the hospital setting, the remaining hospital days are more resource-intensive and costly. Morrisey et. at. consider only explicit incentives created by regulation. More generally, however, any influence that tends to reduce utilization will tend also to increase the measured price or expenditure per unit of care. This occurs because the reduction in utilization is not spread randomly across days, admissions, or visits, but rather is disproportionately targeted on the least acute (and therefore least costly) days or admissions so that the mean expenditure measured over the days, admissions or visits that remain rises. A casemix index sufficient to compensate for such change remains some years off.

Figure 1

COMPONENTS OF PART A EXPENDITURES PER ENROLLEE:
BY QUARTER, 1981–1986



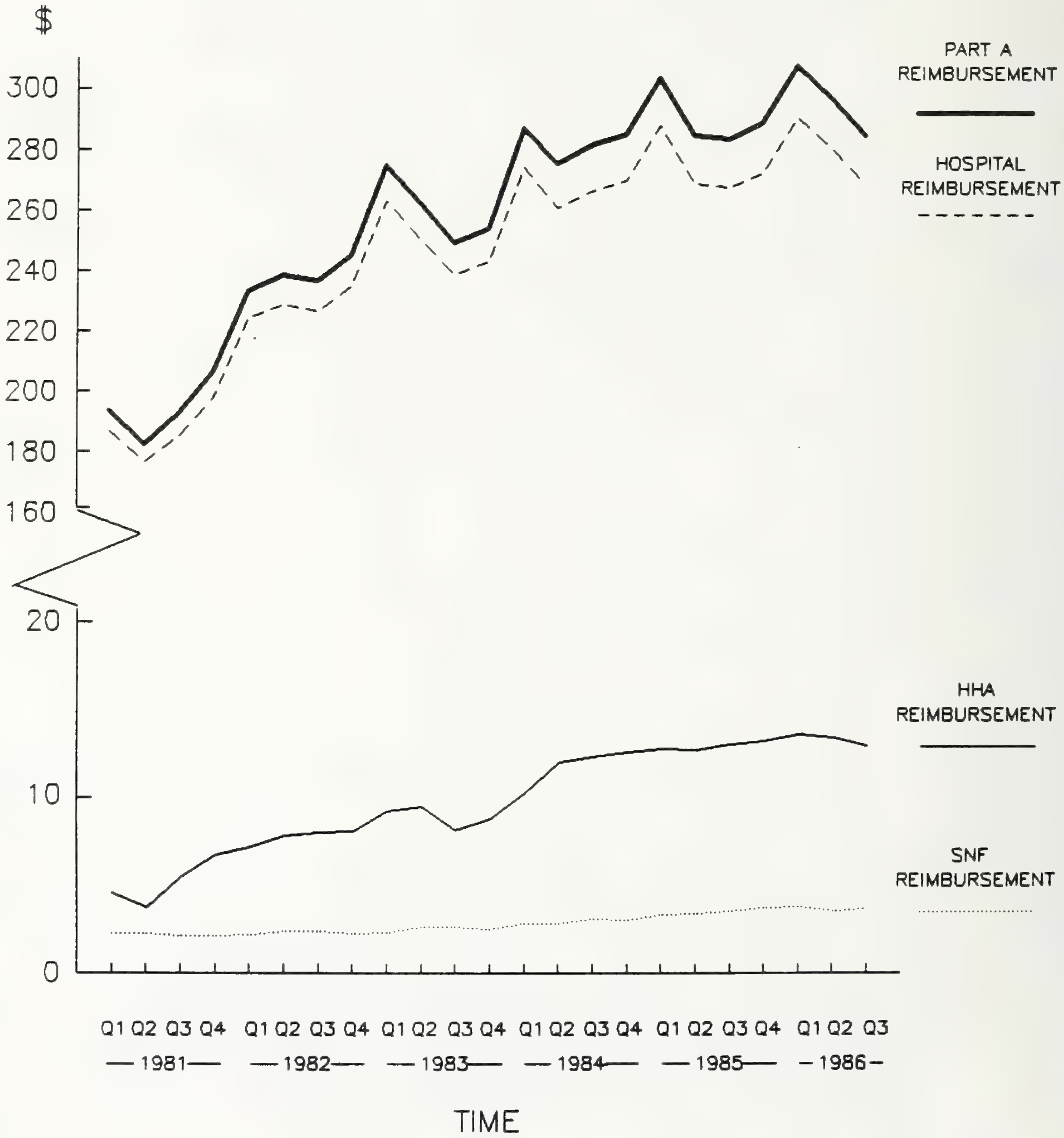
Note: Part A reimbursements for hospice care not included.

Figure 2

COMPONENTS OF PART A EXPENDITURES PER ENROLLEE:

BY QUARTER, 1981-1986

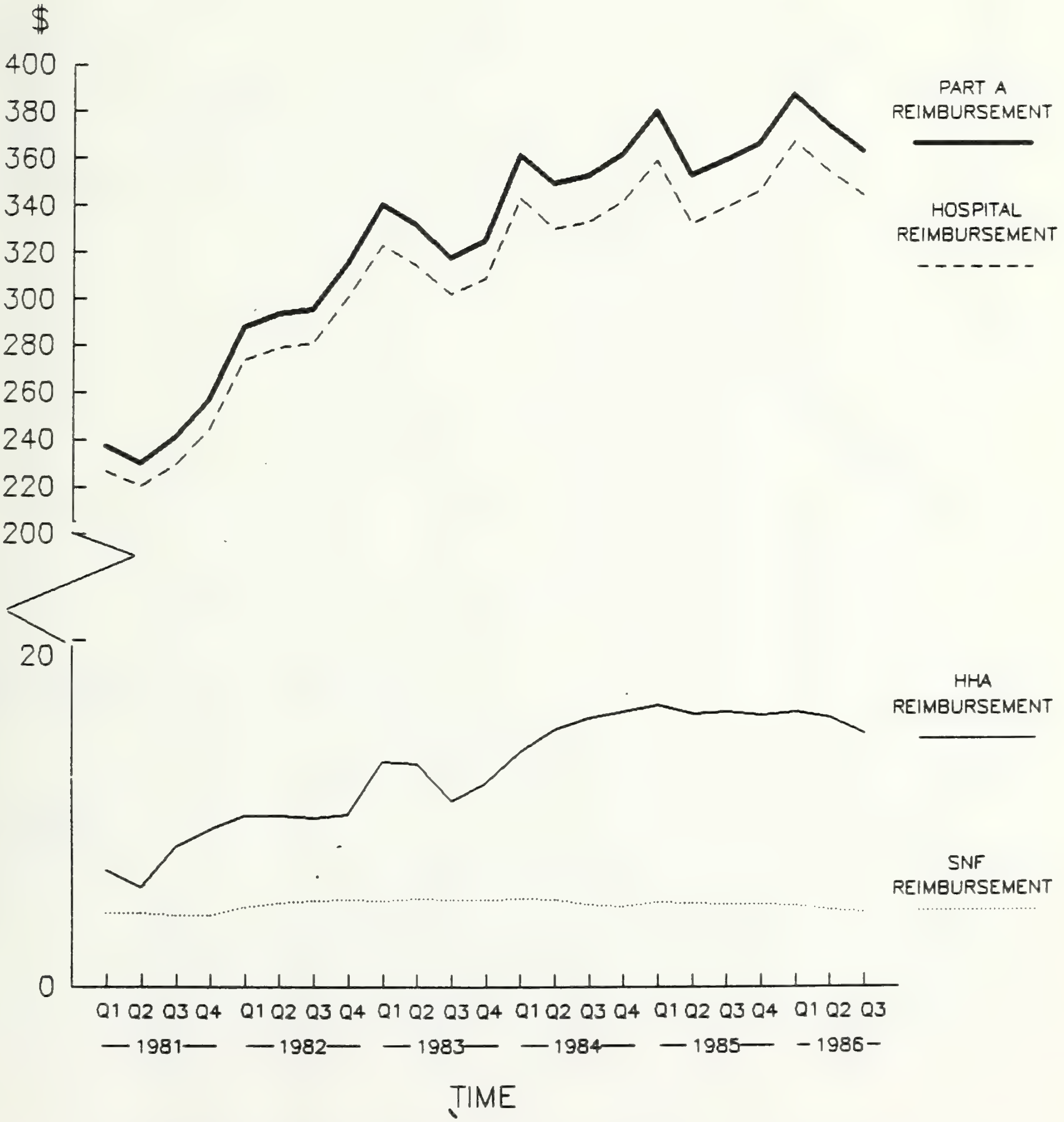
RURAL



Note: Part A reimbursements for hospice care not included.

Figure 3

COMPONENTS OF PART A EXPENDITURES PER ENROLLEE:
BY QUARTER, 1981–1986
URBAN



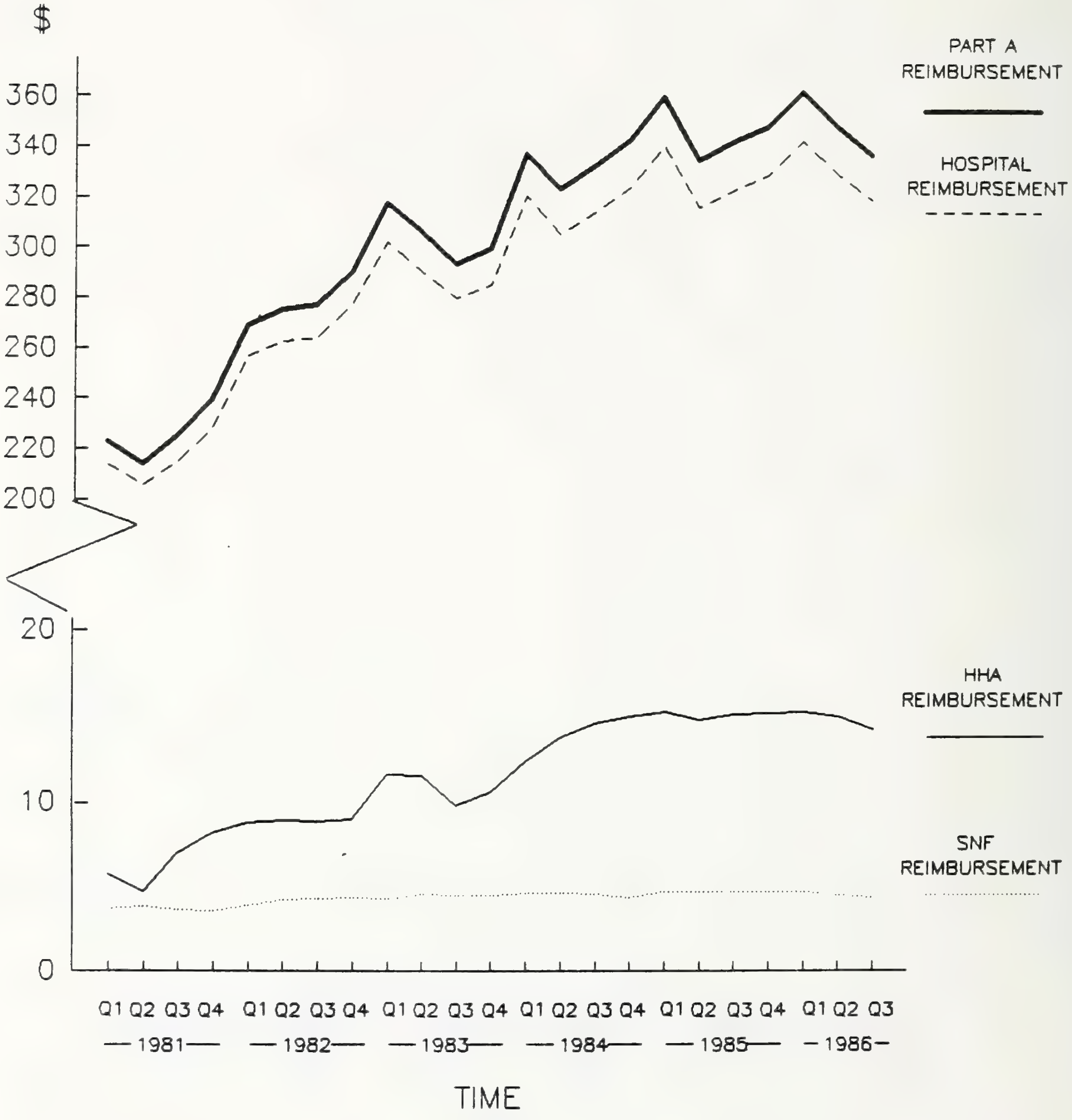
Note: Part A reimbursements for hospice care not included.

Figure 4

COMPONENTS OF PART A EXPENDITURES PER ENROLLEE:

BY QUARTER, 1981–1986

NON–WAIVERED STATES

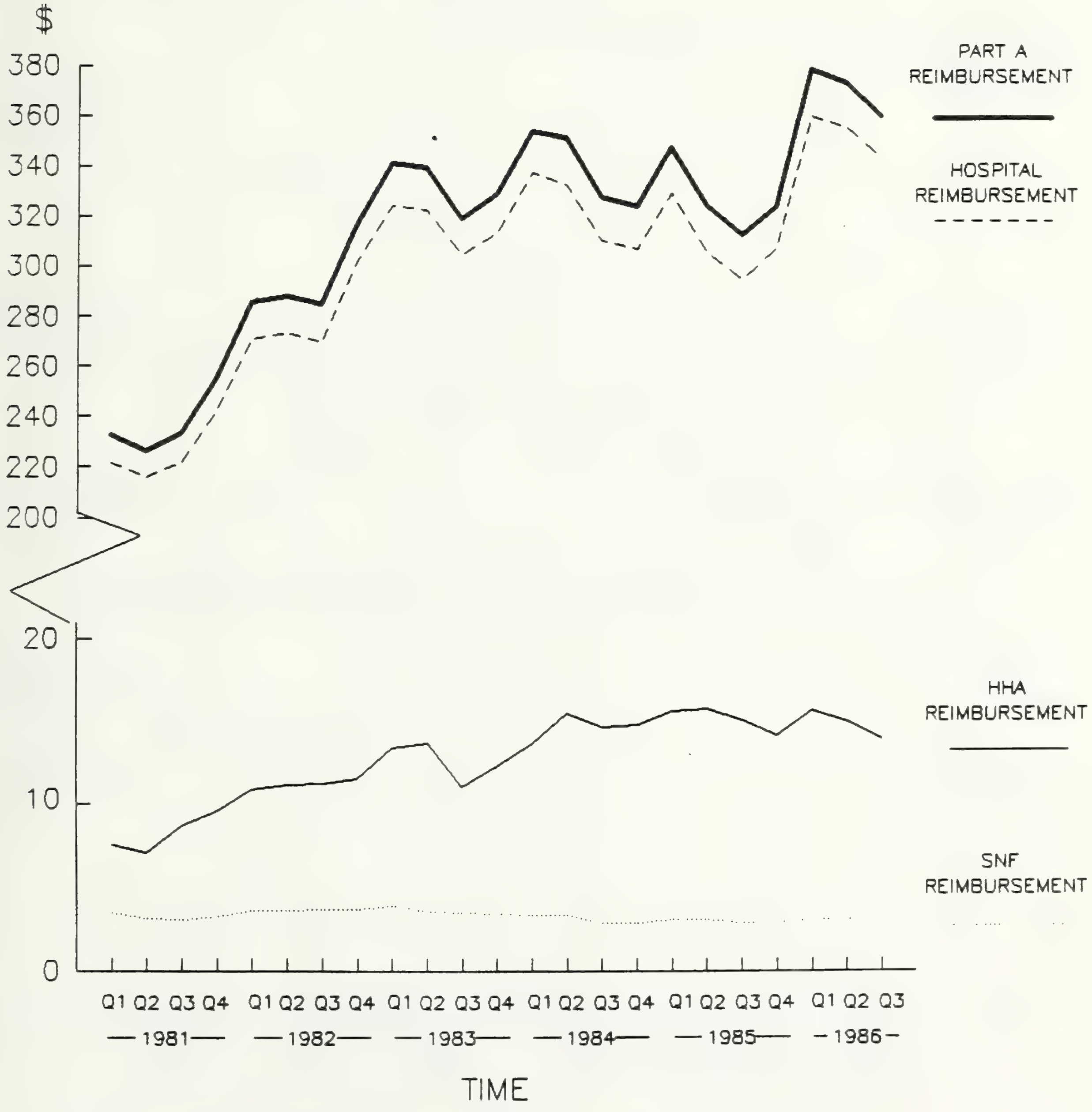


Note: Part A reimbursements for hospice care not included.

Figure 5

COMPONENTS OF PART A EXPENDITURES PER ENROLLEE: BY QUARTER, 1981–1986

WAIVERED STATES



Note: Part A reimbursements for hospice care not included.

Figure 6

DIMENSIONS OF PART A HOSPITAL EXPENDITURES: 1981-1986

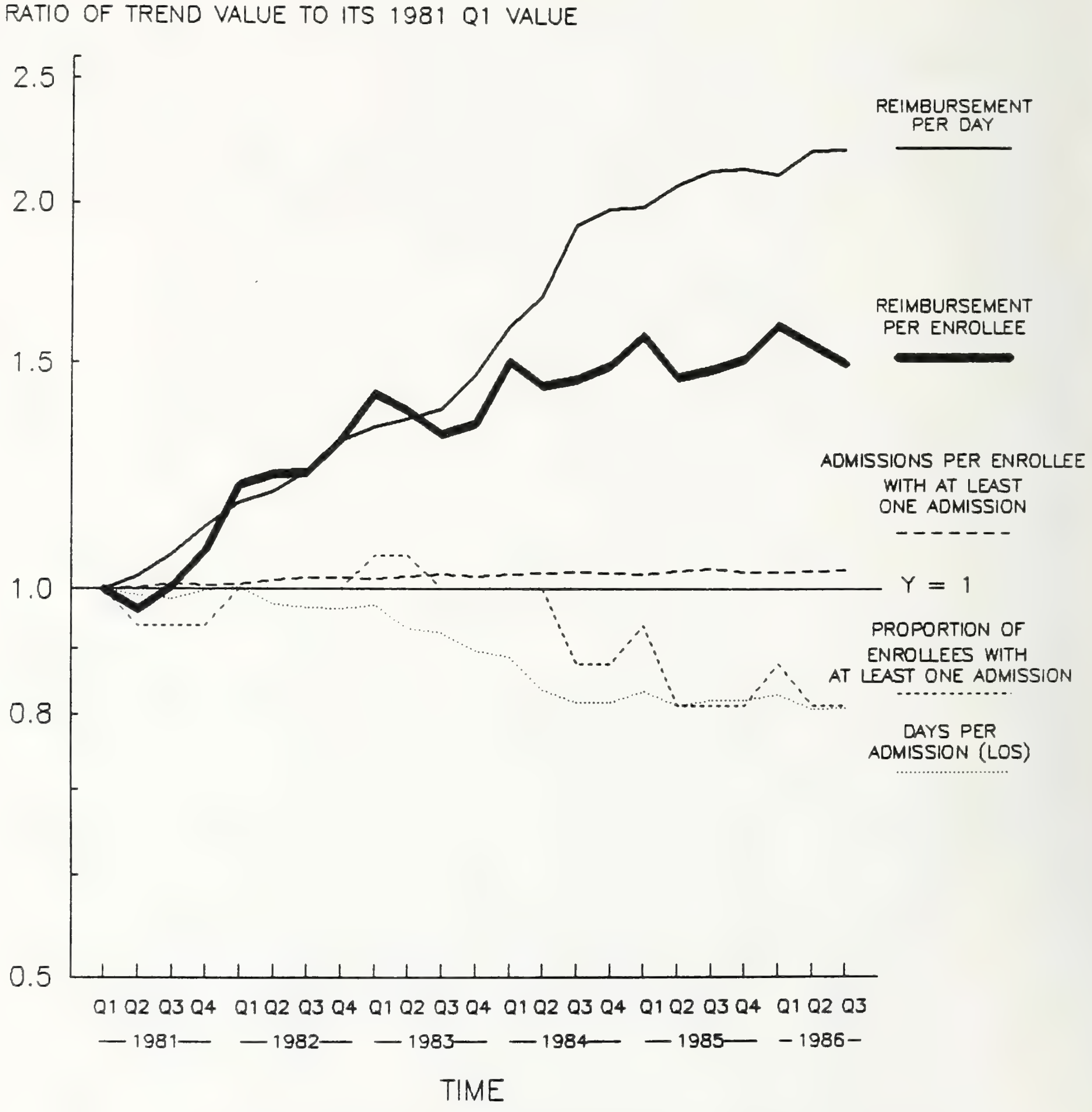


Figure 7

DIMENSIONS OF PART A HOSPITAL EXPENDITURES:

1981–1986

RURAL

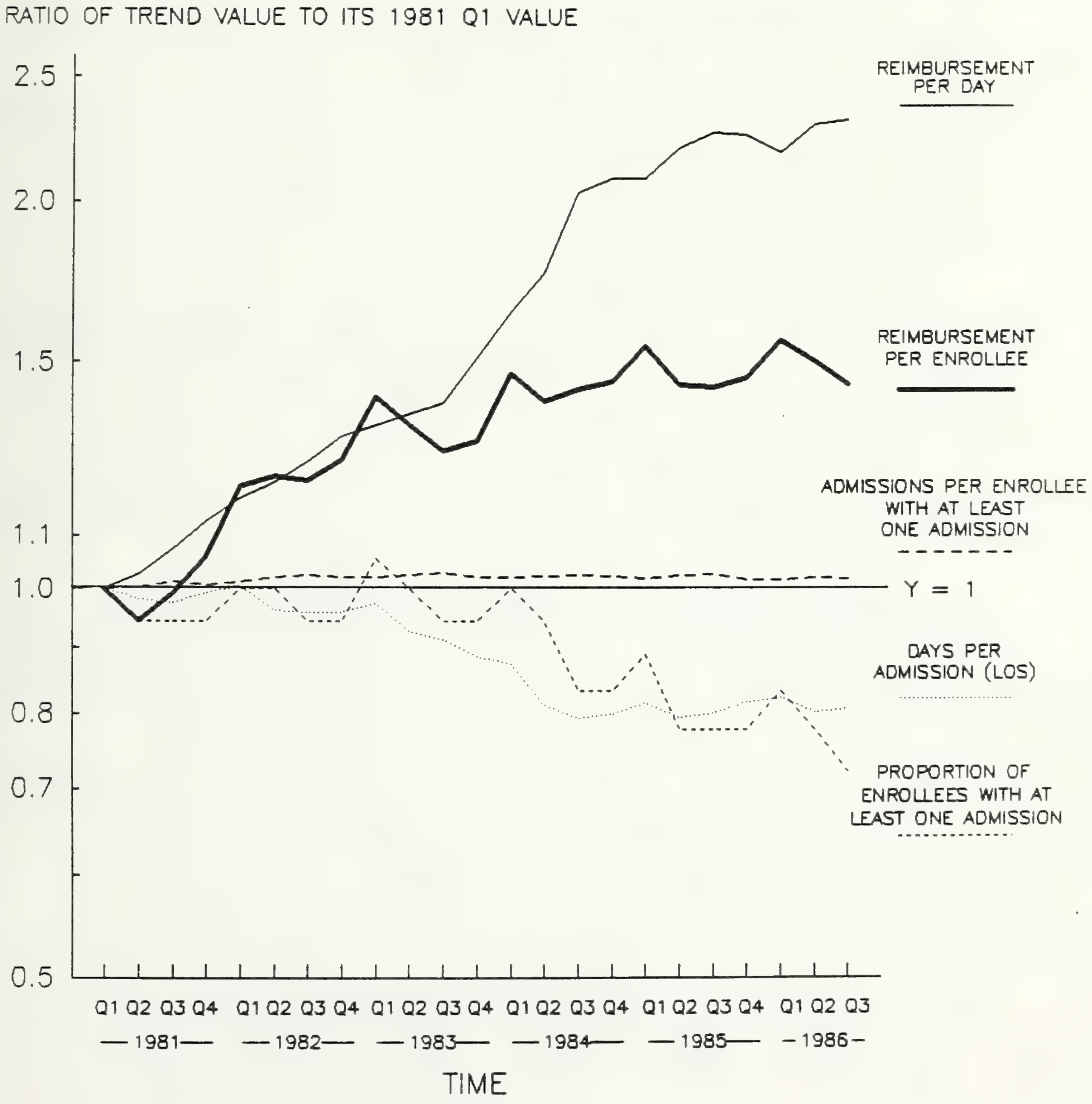


Figure 8

DIMENSIONS OF PART A HOSPITAL EXPENDITURES:
1981–1986
URBAN

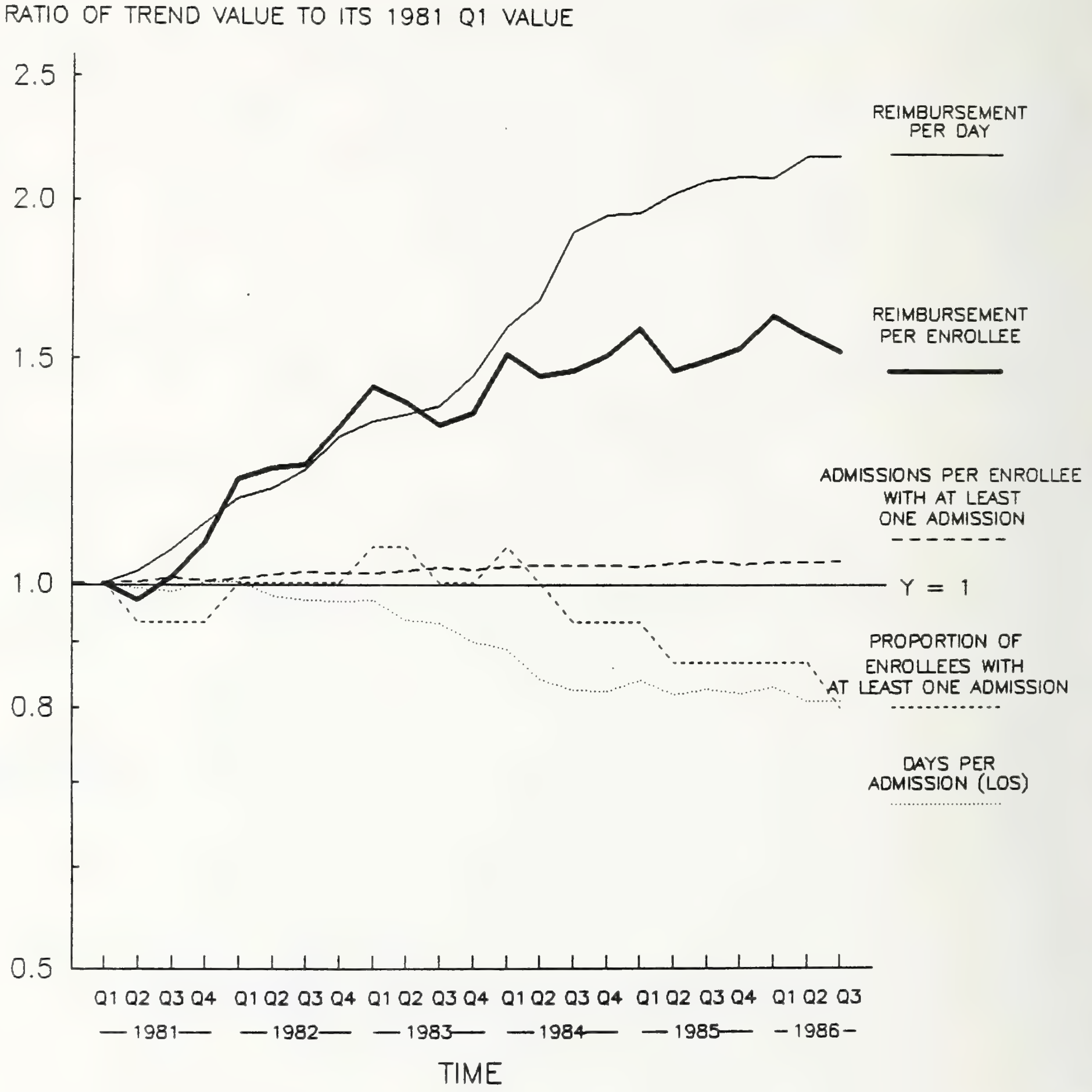


Figure 9

DIMENSIONS OF PART A HOSPITAL EXPENDITURES: 1981–1986
NON–WAIVER STATES

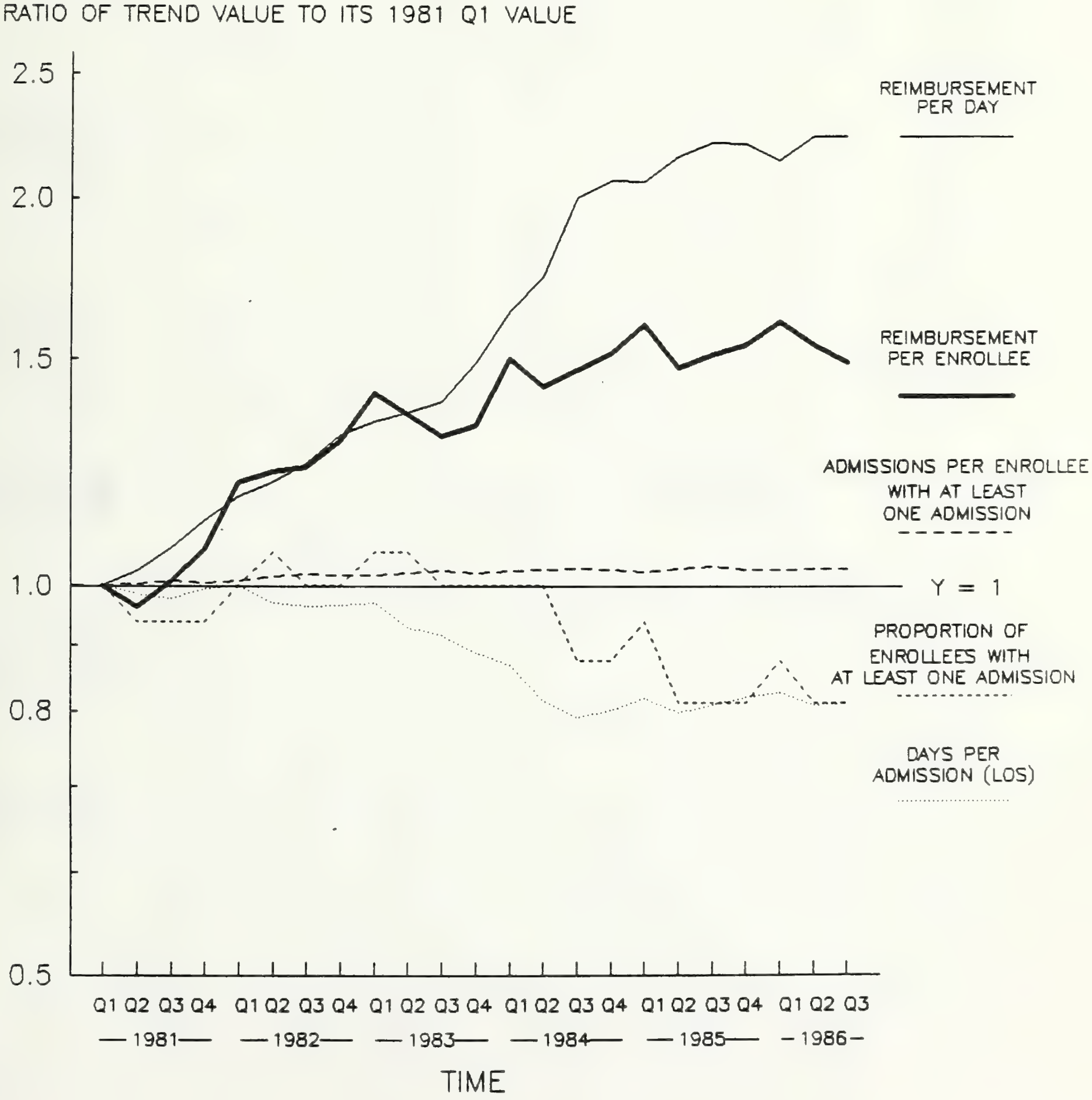


Figure 10

DIMENSIONS OF PART A HOSPITAL EXPENDITURES:

1981–1986

WAIVER STATES

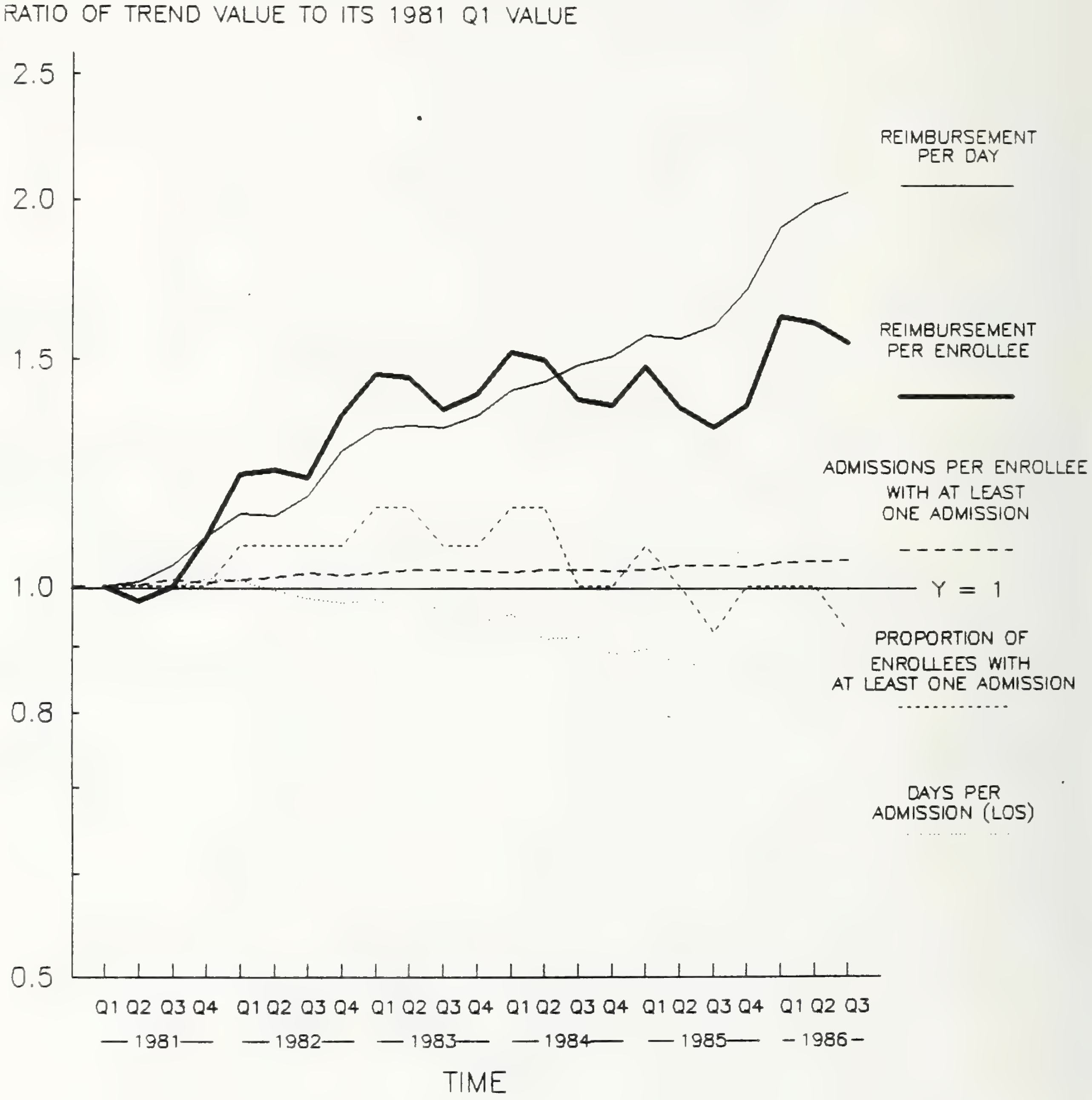


Figure 11

DIMENSIONS OF PART A SNF EXPENDITURES:
BY QUARTER, 1981-1986

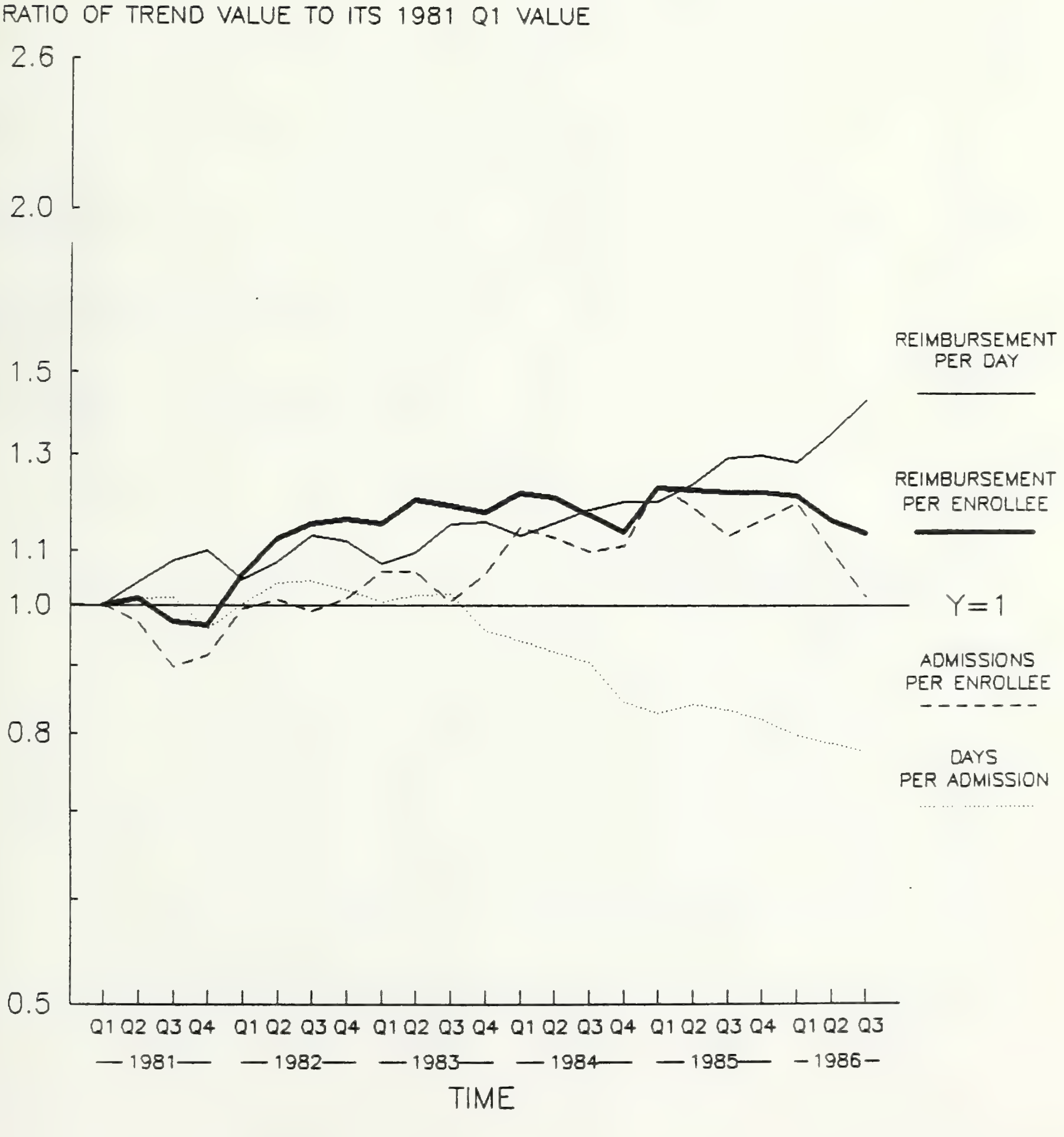


Figure 12

DIMENSIONS OF PART A SNF EXPENDITURES: BY QUARTER, 1981-1986

RURAL

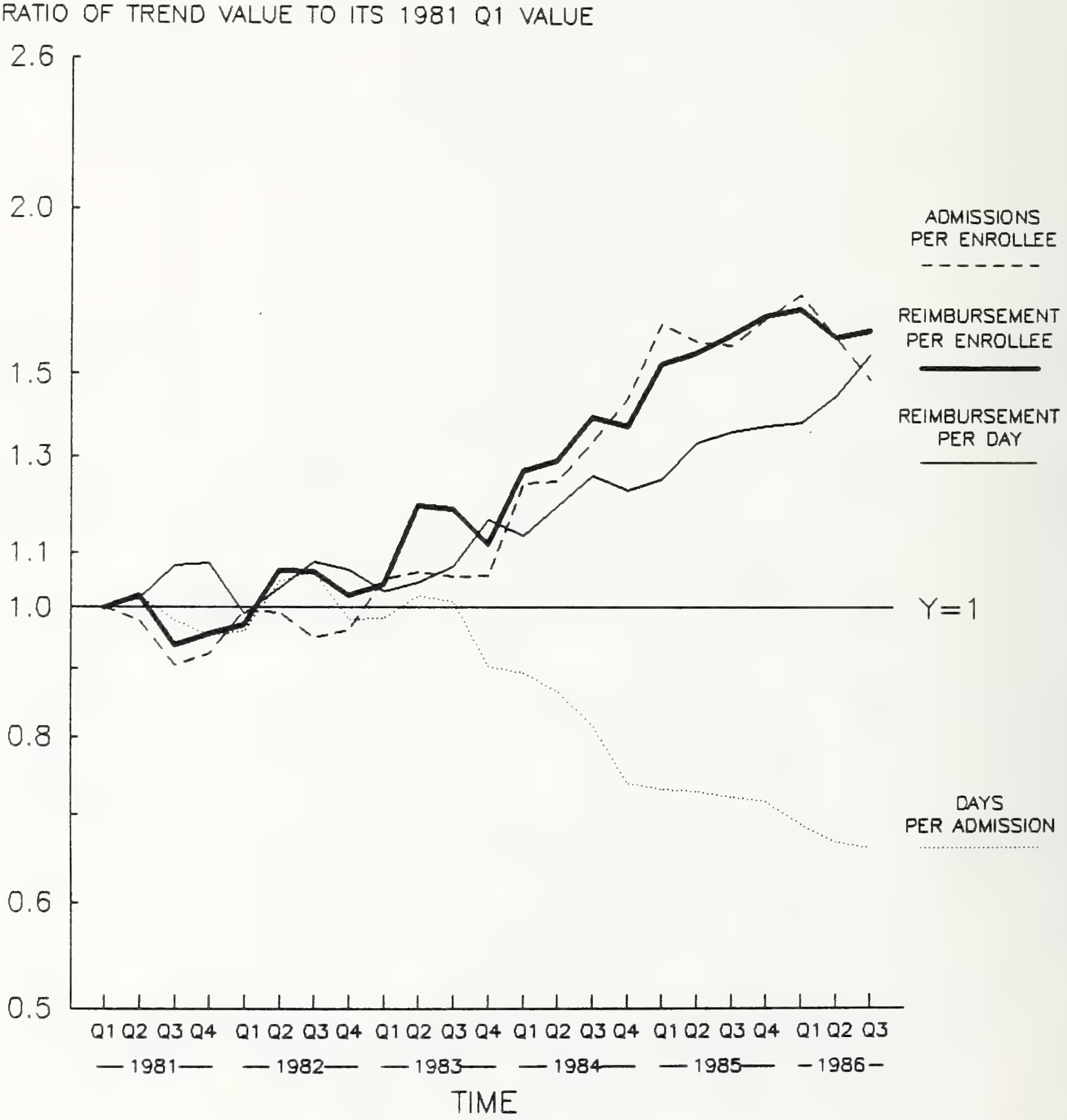


Figure 13

DIMENSIONS OF PART A SNF EXPENDITURES: BY QUARTER, 1981–1986

URBAN

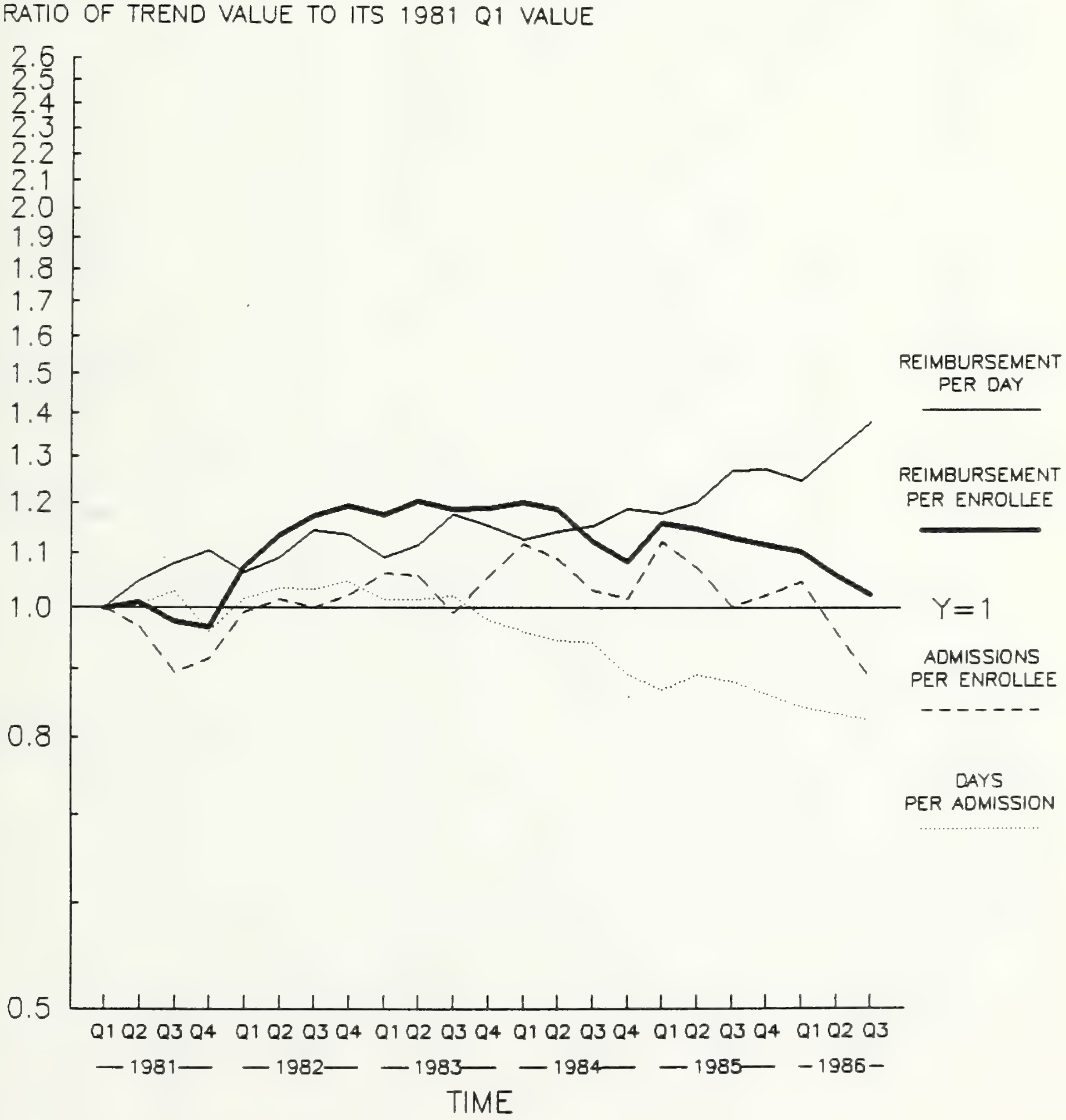


Figure 14

DIMENSIONS OF PART A SNF EXPENDITURES:
BY QUARTER, 1981-1986
NON-WAIVERED STATES

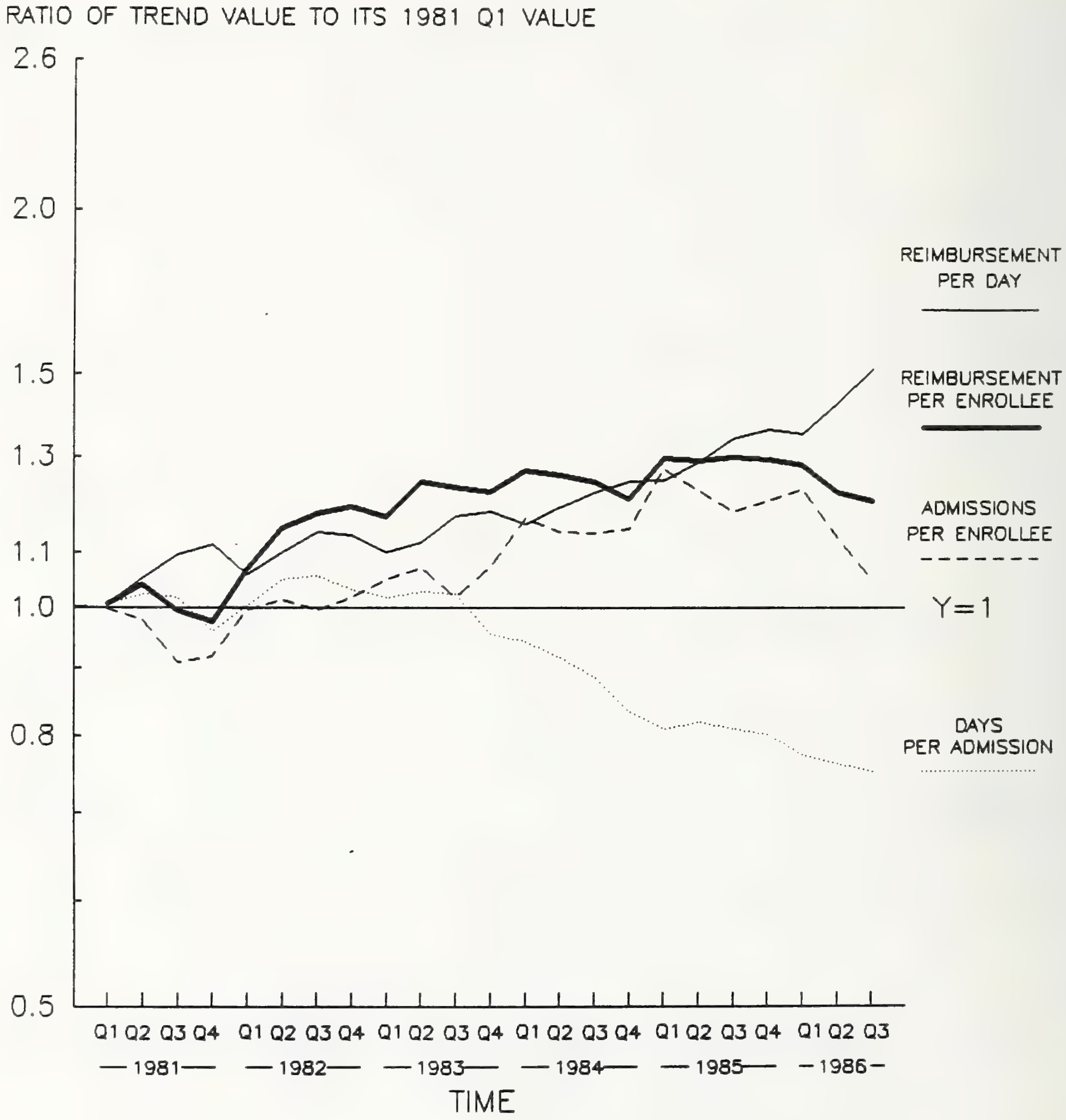


Figure 15

DIMENSIONS OF PART A SNF EXPENDITURES:

BY QUARTER, 1981-1986

WAIVERED STATES

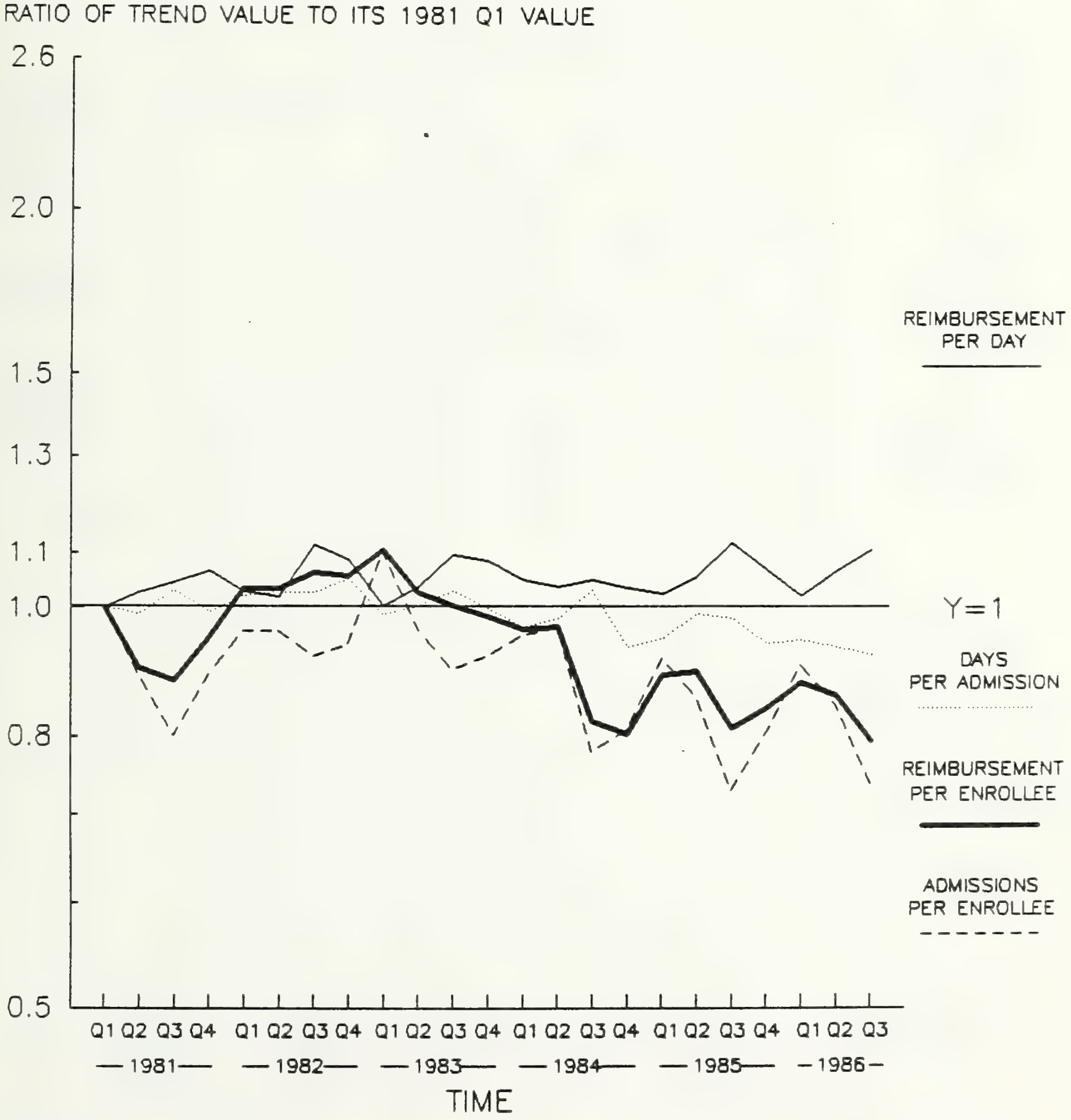


Figure 16

DIMENSIONS OF HHA EXPENDITURES:

BY QUARTER, 1981-1986

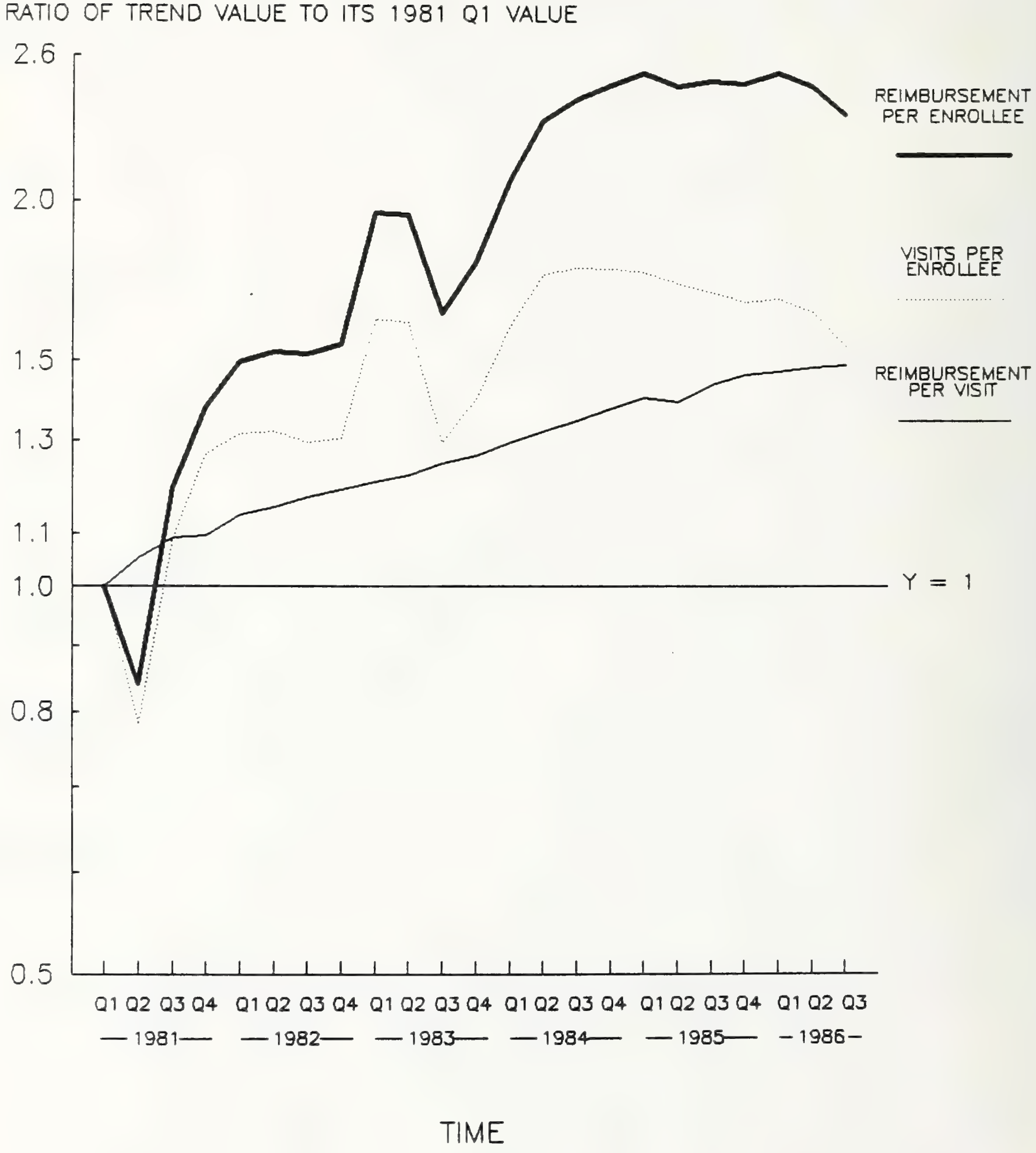


Figure 17

DIMENSIONS OF HHA EXPENDITURES:

BY QUARTER, 1981–1986

RURAL

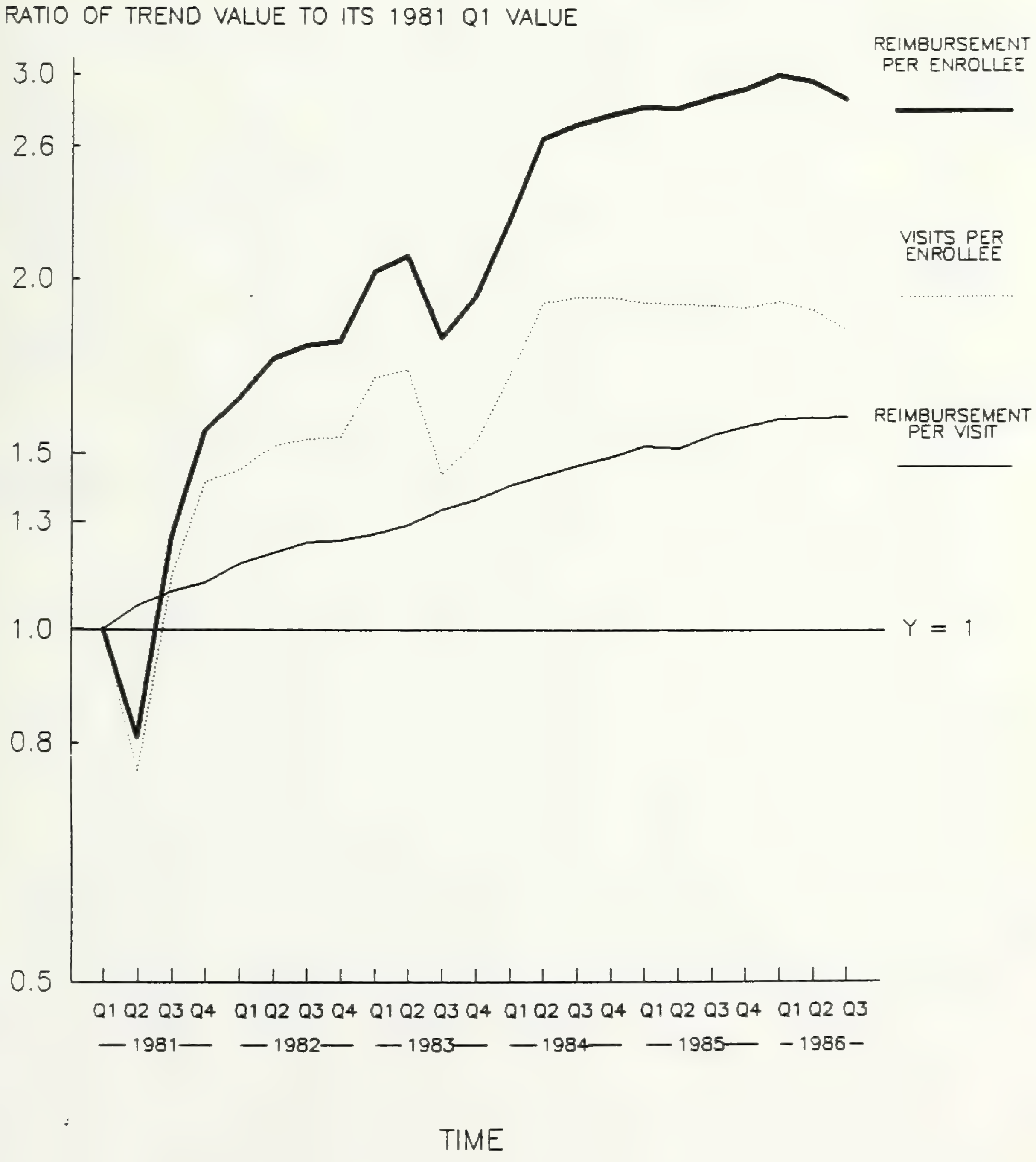


Figure 18

DIMENSIONS OF HHA EXPENDITURES:

BY QUARTER, 1981-1986

URBAN

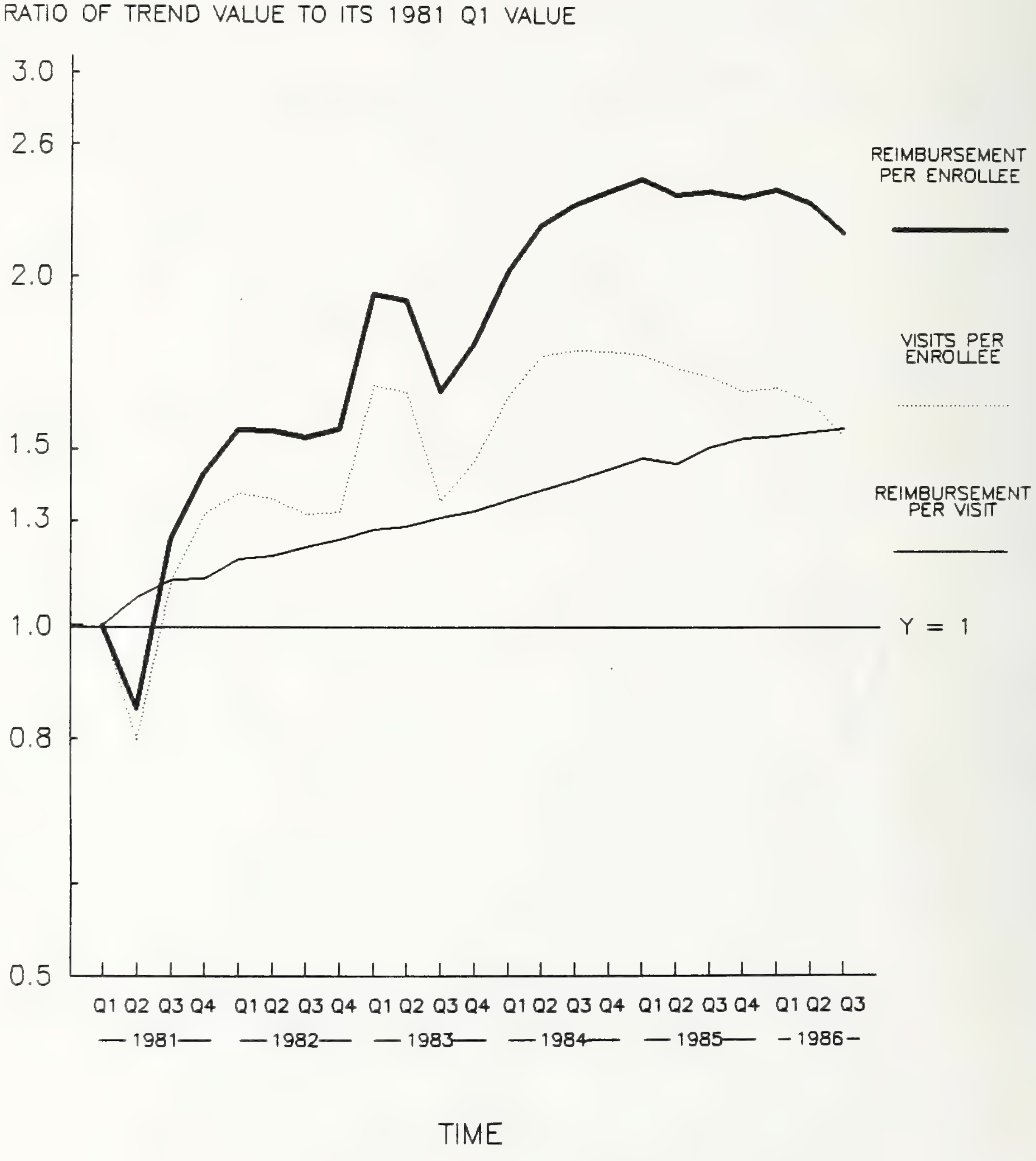


Figure 19

DIMENSIONS OF HHA EXPENDITURES:

BY QUARTER, 1981-1986

NONWAIVERED STATES

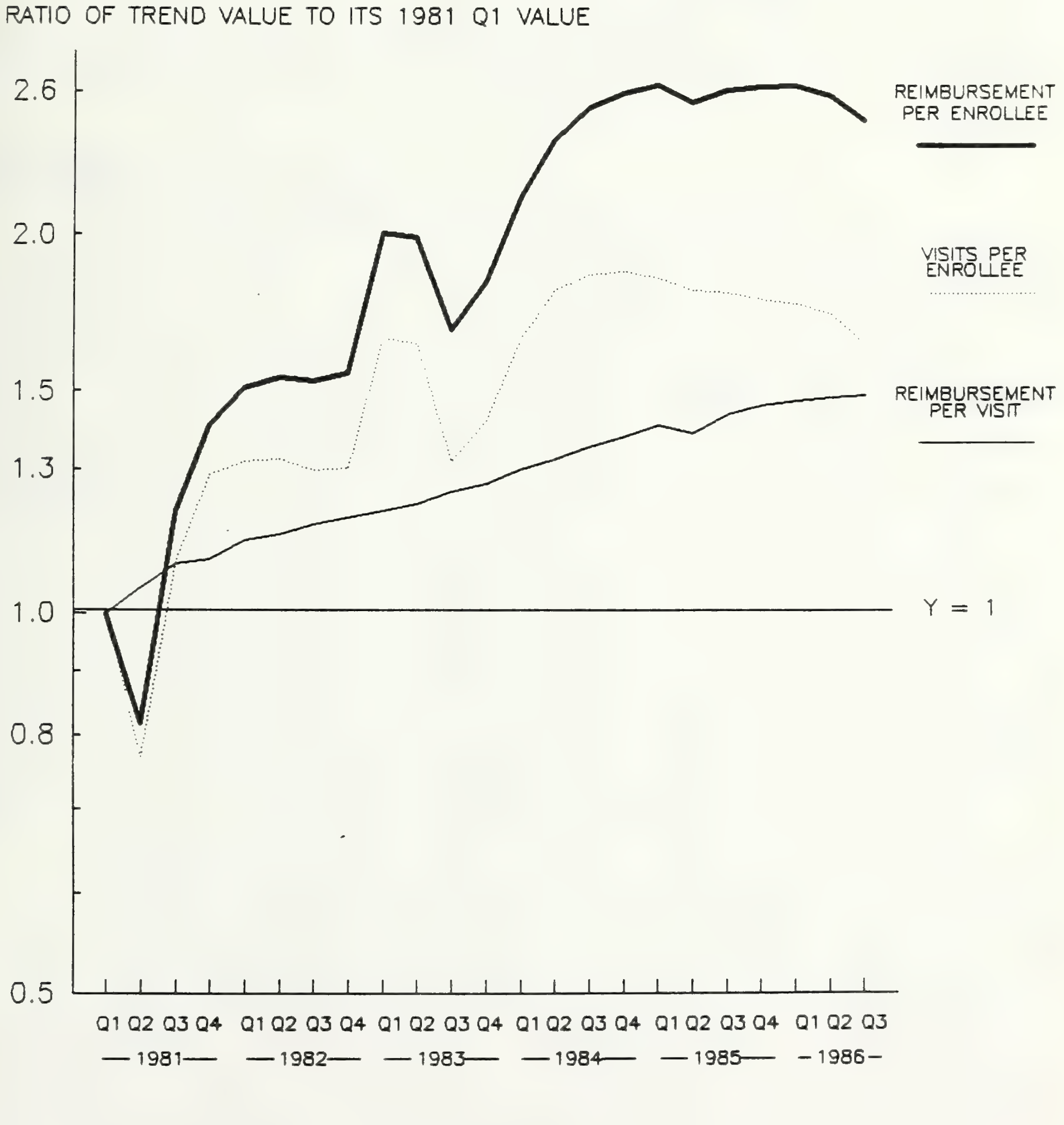
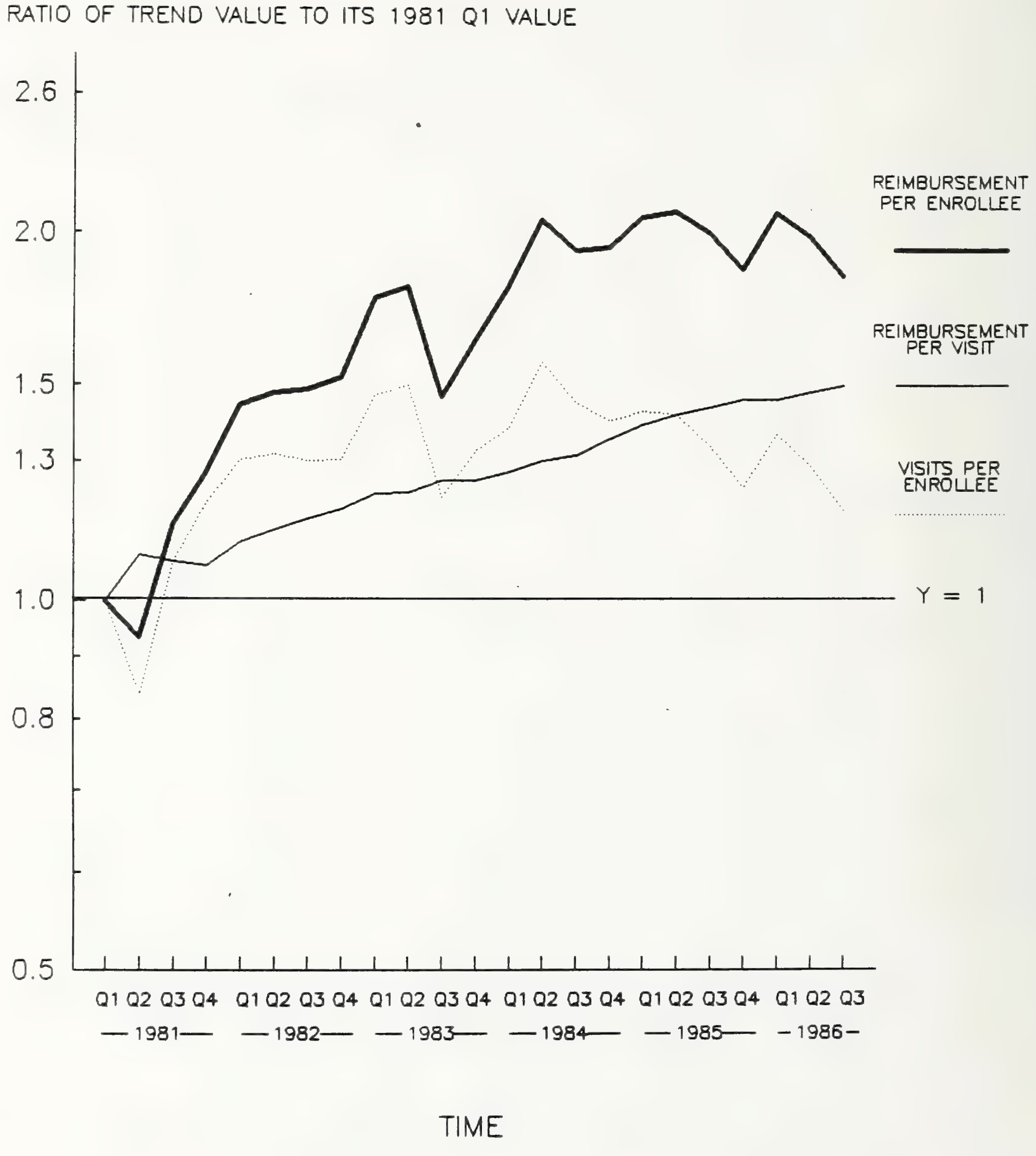


Figure 20

DIMENSIONS OF HHA EXPENDITURES:

BY QUARTER, 1981-1986

WAIVERED STATES



IV. METHODOLOGICAL ISSUES IN THE USE OF REGRESSION TO ESTIMATE THE EFFECTS OF PPS ON PART A UTILIZATION

The analytic work reported in this paper is directed at measuring, insofar as possible, the effect of the prospective payment system on utilization of hospital care and the consequent effects on care provided by home health agencies and skilled nursing facilities. That these effects remain uncertain five years after the implementation of PPS testifies to the difficulties of such measurement. This chapter discusses some of the problems encountered in attempting to isolate the influence of PPS from other variables affecting utilization. The appendix delineates some of the advantages to using a time series - cross section data file, like the one used for this paper.

PPS Effects are Difficult to Detect

It should be noted at the outset that there is no unambiguous and straightforward way of measuring the effects of the Prospective Payment System on quantities of or payments for health care provided under Part A of Medicare. Had PPS been implemented in a randomly selected group of hospitals or geographical areas while other hospitals or areas continued to be reimbursed at cost, then a proper comparison of changes in utilization and payment between the two groups could arguably constitute an unbiased estimate of the effect of PPS. In fact, PPS was implemented in all short-term hospitals in the U.S. on fiscal year anniversaries beginning on October 1, 1983. Only hospitals in the so-called waivered states (Maryland, Massachusetts, New Jersey and New York) were exempt. Each of these states had previously implemented some form of prospective reimbursement for Medicare inpatient hospital services; waivers were granted on the basis of these programs. Hence, simple comparisons between states operating under PPS and states operating under waivers from PPS cannot generate reliable estimates of the effect of changing from a system of cost reimbursement to a system of prospective payment on the utilization of Medicare services.

The distinction between the effects of the Prospective Payment System (PPS) and the effects of prospective payment itself is worth emphasizing before proceeding further. While prospective payment refers simply to a mechanism that links hospital payment to the admitting diagnosis of a Medicare patient, regardless of incurred cost, the PPS encompasses all aspects of hospital payment contained in Pub. L. 98-21, the Social Security Amendments of 1983. Though implementation of prospective payment was the primary feature of the law, it contained other provisions as well, most notably tighter peer review of the appropriateness of hospital admissions. This combination of

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED MORTALITY

provisions (prospective payment plus peer review) may well account for the failure of Medicare hospital admissions to rise after 1983 as was widely predicted. Interviews with hospital administrators and physicians, conducted by Abt Associates in late 1986, indicated a widespread effort to review admissions in light of criteria used by Peer Review Organizations (PROs). This concern over possible denial of payment for admissions as a result of PRO review may well have attenuated or dominated the incentive to increase admissions when cost reimbursement is replaced by prospective payment. It is not possible in general, to discriminate the effects of prospective payment itself from other aspects of PPS rulemaking (such as PRO review). Indeed, as the subsequent discussion suggests, distinguishing gross PPS effects is itself a formidable task.

The absence of a reliable comparison group eliminates the possibility of a straightforward estimator of PPS effects. The best means of approximating the effects of PPS on hospital admissions, rehospitalizations, length of stay, and other measures of medical care is probably to develop a set of "pre-post" (before and after) comparisons as broad indicators. As a rule, comparisons of utilization and reimbursement before and after the inception of PPS are unlikely to reveal pure PPS effects. Changing private and governmental cost containment programs, evolving patterns of practice, and varying rates of change in input prices all influence levels of health care utilization. Differences before and after PPS are thus an amalgam of PPS effects and numerous other extraneous factors. "Pre-post" comparisons will approximate true PPS effects only to the extent that these effects are dominant in the period under study.

An alternative way to approximate the effect of PPS on some measure of utilization, say hospital length-of-stay (LOS), is the "double difference" measure. If the superscripts W and P represent waivered and PPS states and if subscripts B and A represent periods before and after the implementation of PPS, then the double difference in length of stay is:

$$\mathrm{DDL} = (\mathrm{LOS}_A^P - \mathrm{LOS}_B^P) - (\mathrm{LOS}_A^W - \mathrm{LOS}_B^W)$$

To the extent that influences on length of stay other than PPS affected nonwaivered and waivered states roughly equally, this "difference in differences" will estimate the effect of PPS on length of stay. The terms in parentheses represent changes in length of stay in nonwaivered and waivered states between time B and time A. If it is assumed that influences causing length of stay to change are the same in the two areas except for the institution of PPS in the non-waivered states, then all effects save for PPS effects are differenced out of the equation and DDL is an unbiased estimator of PPS effects. The immediate disadvantage of the double-difference estimator is its greater sampling variance, roughly twice that of the pre-post (single difference) estimator. Which of the two has smaller bias is a matter of judgment and cannot be determined a priori. Bias in the pre-post estimator arises from factors other than PPS that cause length of stay to change in nonwaivered states during the period under study. Bias in the double-difference estimator arises from factors other than PPS that cause length of stay to change in waiver states relative to nonwaiver states during the period. In general terms, the pre-post estimator will exhibit less bias to the extent that PPS is the dominant effect on length of stay in nonwaivered states. The double-difference estimator will exhibit less bias if there are factors other than PPS causing length of stay to change and if these other factors have similar effects in waivered and nonwaivered states.

The double difference estimator DDL may easily be replicated in a linear regression equation. If WAIVER is defined as an indicator variable which takes on a value of one for waivered states and zero otherwise and if POST is an indicator variable that takes on the value one for periods after the implementation of PPS and is zero otherwise, then the estimated regression coefficient β_3 in the equation below (estimated by ordinary least squares) is identical to DDL.

$$\text{LOS} = \beta_0 + \beta_1\text{WAIVER} + \beta_2\text{POST} + \beta_3(1-\text{WAIVER})*\text{POST} + \varepsilon \tag{4.1}$$

The efficiency with which this estimate of the effect of PPS on length of stay is estimated may be increased by adding other variables likely to be correlated with length of stay to the right-hand side of equation (4.1). The next chapter describes the other covariates used in the OLS regression models estimated in this paper.

Timing the Implementation of PPS

Further complicating the problems presented by the absence of a realistic comparison group is the temporal character of the PPS "treatment". Hospitals entered PPS on their fiscal year anniversaries, beginning on October 1, 1983. Some hospitals had not yet entered more than a year after this date, though a bare majority were subject to PPS by January, 1984. This phasing-in of PPS almost surely will muddy the observed effects when using a geographically aggegated file. Furthermore, the emergence of PPS effects may have preceded its implementation in some areas, due to anticipatory behavior by hospitals; the effects may have strengthened or diminished in the years after implementation as a result of learning. As a practical matter then, designating particular times as "before" and "after" PPS for purposes of constructing a pre-post estimator (that is, deciding when POST should be set equal to one) is largely a matter of guesswork. Since the file contains six years of data, alternative measures will be simple to construct, but no standard for selecting the best is available.

The reimbursement provisions of TEFRA also hinder the selection of an appropriate "before" period. Most hospitals were subject to TEFRA in the year immediately preceding their entry onto PPS. Some features of PPS appeared, in somewhat milder form, in TEFRA. In particular, PPS was designed to be budget neutral with respect to the target reimbursements established by TEFRA. Under these conditions, it is unlikely that TEFRA and PPS influences could be clearly disentangled. Among the alternative estimators of PPS effects presented below are several that combine 1983 and 1984 into an "after" period and so represent combined TEFRA/PPS effects.

A related difficulty is the proper treatment of New York and Massachusetts. Both states received waivers from PPS and continued to operate under previously established state prospective reimbursement programs in 1984. In late 1985, however, Massachusetts hospitals lost their waivered status and joined the prospective payment system. New York hospitals joined PPS in January, 1986. The question is how to classify these two states in 1986. Recall that the rationale for the double difference estimator was that the variable WAIVER captures underlying differences between the four waivered states and all other states and that the change in hospital payment under PPS was assumed to be the only influence differentially affecting PPS and waivered states during the period. If WAIVER were set equal to zero for New York and Massachusetts in 1986, then characteristics specific to these two states would become confounded with PPS effects; if they continue to be classified as waivered states in 1986, then the PPS effect estimated by β_3 in equation (4.1), will be over- or underestimated to some extent, depending on whether the effect of PPS on length of stay is smaller or greater than the effect on length of stay of the New York and Massachusetts state reimbursement programs.

For the most part, the analysis of this paper adopts the latter strategy, defining New York and Massachusetts to be waivered states in 1986 and including a dummy variable equal to one for areas in the two states in 1986. As a check on the results, some equations were re-estimated with New York and Massachusetts eliminated from the data in 1986 and also with all data from 1986 removed. Neither procedure changed the estimates significantly.

Eight Estimators of PPS Effects

Because no method of estimating PPS effects can be isolated as clearly superior to all others, the strategy employed in this paper will be to compute a number of alternative measures in the hope that these measures will jointly bound the true effect of PPS on specified measures of Medicare utilization. All of the measures represent some combination of pre-post and waiver-nonwaiver comparisons; all use either 1984 or 1983/84 as the "post-PPS" period and so capture only immediate PPS effects. These immediate effects will obviously understate the long-run effects of PPS if Medicare utilization continued to change in 1985 and beyond in response to PPS. Immediate effects will overstate the long-run effects of utilization "over-reacted" in 1984.[1]

The eight estimators of PPS effect reported in Chapters VI and VII are described below. In practice, each is computed using estimated coefficients from a regression model that adjusts for certain local characteristics. The estimators are described here in simpler form to avoid bogging down the exposition in notational detail. The regression form of the estimators is presented in Chapter V.

Estimators Using Nonwaivered States Only (Pre-Post

Four estimators use differences in utilization over time as an approximation of PPS effects.

Estimator 1: 1984 First Difference. The simple difference in utilization per capita between 1983 and 1984 is used to measure the effects of PPS. This is the simplest pre-post estimator. Estimator 1 does not distinguish PPS effects from other influences that caused utilization to change between 1983 and 1984. Moreover, using 1983, a year that may be dominated by effects of TEFRA and also by anticipation of the implementation of PPS, as a base year may lead to significant bias in the estimator.

Estimator 2: Combined 1983/84 First Difference. The average of the differences in utilization per capita in 1982 and 1983 and in 1983 and 1984 is used as an estimate of joint PPS/TEFRA effects. Again, influences on utilization other than PPS and TEFRA will be incorporated into Estimator 2.

Estimator 3: 1984 Second Difference. As the name implies, second difference estimators represent a "difference between differences." Estimator 3 compares the difference in per capita utilization between 1983 and 1984 with the difference in utilization between 1981 and 1982. That is, it equals Estimator 1 minus the difference in per capita utilization between 1981 and 1982. Estimator 3 attributes differences in the rate of change between the periods to PPS.

---

[1] After a sharp decline in 1983-84 in waivered states, hospital length of stay trended slightly upward in 1985-86, suggesting that such an over-reaction by hospitals might have occurred.

Estimator 4: Combined 1983/84 Second Difference. The differences in utilization between 1981 and 1982 is subtracted from Estimator 2 to form an estimate of PPS/TEFRA effects. Estimators 3 and 4 require the assumption that in the absence of PPS or TEFRA the rate of change in utilization per capita in 1983 and 1984 would have been approximately the same as the rate of change in 1982.

Estimators Combining Nonwaivered and Waivered States (Double-Difference)

Simple comparisons of utilization in waivered and nonwaivered states are of little value in estimating the effects of PPS, since significant differences between these four states and the rest of the U.S. can be found long before the implementation of PPS or TEFRA. The waivered states may be useful, however, if one is willing to assume that changes other than those due to PPS and TEFRA that occurred in nonwaivered states in 1983 and 1984 occurred also in the waivered states. In particular, one must assume that most effects of the waivered states' reimbursement mechanisms had occurred by 1983 or 1984.

Estimator 5: 1984 First Difference, Waiver/Nonwaiver. The difference between utilization per capita between 1983 and 1984 in waivered states is subtracted from the same difference for nonwaivered states. Estimator 5 is a simple double-difference estimator described earlier in the chapter. Changes in utilization between 1983 and 1984 are assumed to have been similar in nonwaivered and waivered states except for changes due to PPS in nonwaivered states.

Estimator 6: Combined 1983/84 First Difference, Waiver/Nonwaiver. The average of 1982-83 and 1983-84 differences in per capita utilization in waivered states is subtracted from a similar average of differences for nonwaivered states as an estimate of PPS/TEFRA effects. Estimator 6 is a double-difference analogue of Estimator 2.

Estimator 7: 1984 Second Difference, Waiver/Nonwaiver. Estimator 7 is a waiver/nonwaiver comparison of the difference between utilization per capita in 1983 and 1984 minus the difference between utilization per capita in 1981 and 1982. It is tempting to refer to Estimator 7 as a "triple difference estimator" since three levels of differencing are performed. This estimator may be calculated simply as the difference between Estimator 3, computed for nonwaiver states and Estimator 3, computed for waiver states. Estimator 8 measures PPS effects if the difference between rates of change in utilization in 1981-82 and 1983-84 in waivered states is a good proxy for the difference in rates of change that would have occurred in nonwaivered states in the absence of PPS. As before, the principal danger here is that the continuing adjustment of utilization in waiver states that their reimbursement programs may bias estimated PPS effects.

Estimator 8: Combined 1983/84 Second Difference, Waiver/Nonwaiver. Estimator 8 is simple analogue of Estimator 7 using the average of changes in 1982-83 and 1983-84 as the "post" year. The change in utilization between 1981 and 1982 is subtracted from the average of changes between 1982-83 and 1983-84 for both waivered and nonwaivered states. The figure for waivered states is then subtracted from the figure for nonwaivered states to form the estimator. Like Estimator 7, then, Estimator 8 is a form of "triple difference."

Estimation of Market Influences

A fundamental assumption of the OLS regression model is that all covariates included on the right hand side of the equation must be independent of the disturbance term. Put more colloquially but perhaps more plainly, the covariate (or independent variable) included on the right hand side may influence the value of the dependent variable but is assumed not to be influenced by the dependent variable. In the presence of this reverse causation (more appropriately termed "simultaneity bias"), OLS fails to identify the true effect of changes in the covariate on the dependent variable.

Three variables used as covariates in this paper merit some discussion on this score. Hospital beds per capita and nursing home beds per capita are included in all regressions reported in this paper as measures of local supply. Other things equal, more hospital beds per capita should result in more admissions per enrollee and longer average lengths of stay; more nursing home beds per capita should produce shorter lengths of stay and fewer admissions since these beds substitute (at the margin) for hospital beds. Over the long run, however, the level of hospital and nursing home beds is likely to adjust to local patterns of medical practice so that hospital and nursing home beds per capita may be determined to some degree by admissions and length of stay. The coefficients of these two variables in OLS regressions must therefore be interpreted with caution.

An even greater problem is posed by the third variable, HMO membership per 100 population. The introduction and growth of HMOs in the U.S. has hardly been uniform. HMOs have generally been most attractive (especially to employers) in areas with high health care cost and utilization. The least squares coefficient of HMO enrollment per capita is then a blend of HMO effects on utilization and utilization effects on HMO enrollment. Mclaughlin (1988) finds no statistically significant effects of HMO enrollment on hospital expenses per capita or per admission after controlling for the tendency of HMOs to grow in areas with high expense. OLS regression models may document the association between membership and utilization but are unlikely to reveal the true effect of greater HMO enrollment on utilization. The fixed-effect model, discussed below, should provide improved estimates of the effect of all market variables.

Not All Models Are Correct

This paper presents the results from estimating a variety of regression equations. In comparing the results, it is important to bear in mind that the various specifications cannot all be mutually consistent. For example, the same linear specification is used to estimate the parameters of hospital length of stay, admissions per enrollee and hospital days per enrollee. But if both length of stay and admissions per enrollee are linear in, say physicians per capita, then hospital days per enrollee cannot be linear in this variable. Moreover, if both length of stay and admissions per enrollee are normally distributed, then days per enrollee cannot be. Hence most hypothesis testing relies here on the asymptotic normality of least-squares regression disturbances.

APPENDIX TO CHAPTER IV

Estimation Using a Time Series of Cross Sections

Yet another assumption of the OLS regression model is that disturbance terms (such as ε in equation (4.1)) are independent across observations. This assumption is untenable when using a dataset such as this one which contains 24 quarters of data for each geographical area. It is natural to expect that disturbances for different quarters for a particular area will be correlated with each other. This correlation is ignored in OLS, but can be exploited to produce more precise estimates (i.e. estimates with smaller sampling variances) than are possible with OLS. A variety of generalized least squares (GLS) estimators can be specified; the exploration of alternative GLS specifications including autoregressive, random effects and ARIMA processes is a subject for future work. In this paper a simple fixed effect model will be estimated. The fixed effect model specifies the disturbance term for area i in quarter t as the sum of two components: a constant term f_i that is fixed for each particular area but varies across areas, and a purely random term v_{it} that is independent across areas and across time periods for a particular area. Thus

$$(4.2) \qquad \varepsilon_{it} = f_i + v_{it}; \; E(\varepsilon_{it}\varepsilon_{jt'}) \begin{array}{ll} = f^2 + \mathrm{Var}(v) & \text{for } i=j \text{ and } t=t' \\ = f^2 & \text{for } i=j \text{ and } t\neq t' \\ = 0 & \text{for } i\neq j \text{ and } i\neq t' \end{array}$$

The fixed-effect model as specified here is equivalent to adding a dummy variable for each study area. While this is wasteful of degrees of freedom, it provides an additional bonus. Any correlation between covariates and those elements of the disturbance that are fixed over time are captured by the fixed effect. The simultaneity bias induced by the inclusion of market variables may thus be reduced or eliminated.

To illustrate the point more plainly, consider the problem of estimating the effect of HMO enrollment on utilization. If HMO formation and growth is stimulated to some degree by the level of health care utilization in an area, then some elements included in the error term in a utilization regression that included HMO membership as a covariate would incorrectly be attributed to HMO enrollment. If, however, the correlation of HMO enrollment with the error is primarily due to a correlation with elements that change very little over time, then the effects of this correlation will be largely removed by the fixed-effect model. The term f captures the unchanging elements of area i's underlying patterns of utilization so that the estimate of HMO

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enrollment per capita more nearly estimates the true effect of increasing HMO enrollment on the dependent variable of interest.

One consequence of the method of used here to estimate the fixed effects model is that all variables not changing over time are impounded in f_i. Estimates are reported only for variables that change over time within a particular area.

V. SOURCES OF VARIATION IN MEDICARE USE

The previous chapter outlined a strategy for estimating the effects of PPS and discussed the limitations imposed by the absence of an adequate comparison group and by the gradual phasing-in of hospitals to PPS. This chapter presents specific formulations of the pre-post and double-difference estimators in terms of an underlying linear regression equation. The equations are estimated for several dimensions of hospital, HHA and SNF care. Because the estimators are written in terms of specific covariates included in the model, we first present the variables themselves and their definitions.

Explanatory Variables

1) Seasonal and Trend Effects

Variable Names: SPRING, SUMMER, AUTUMN, AUT86DUM, DYR82-DYR86

Medicare utilization and expenditure display marked seasonality; they are usually highest in the winter and lowest in summer and autumn. The three indicator variables SPRING, SUMMER, and AUTUMN each take on a value of one in the second, third and fourth quarters of the year respectively, and otherwise equal zero.

The variable AUT86DUM takes on a value of one in the fourth quarter of 1986 and is zero otherwise. Some measures of utilization were found to decline sharply in this last quarter of the data. The decline is almost surely the result of lags in the processing of Medicare claims which therefore did not reach the appropriate HCFA analytic claims file. Inclusion of AUT86DUM as a covariate prevents the acquisition of high "leverage" by observations in this period and the consequent mis-estimation of time trend and seasonal coefficients.

Time effects are captured by the indicator variables DYR82 through DYR86. Each of these variables takes on a value of unity if the observation occurred in a year equal to or greater than the year of the variable name. Thus DYR83, for example, is set equal to one for the years 1983 through 1986 and is zero otherwise. By defining the year variables in this way, the coefficient of each year indicator is made to estimate the increase in the dependent variable (other things constant) over the previous year. The variables DYR82 through DYR84 play an important role in the construction of all estimates of PPS effect reported in Chapters VI and VII.

2) Market and Location Effects

Variable Names: URBAN, BENPOP, PHYSPOP, PHYSPOP#, HMOPOP, HMOPOP#, HBEDPOP, HBEDPOP#, NBEDPOP, NBEDPOP#, REGION2-REGION5

URBAN is an indicator variable that takes on a value of one if an area is comprised of one or more Metropolitan Statistical Areas (MSAs) and is zero otherwise. The areas were defined so as not to cross urban-rural boundaries.

BENPOP measures the number of Medicare Part A enrollees per 100 people in the study area. Patterns of medical practice are likely to be more oriented toward Medicare financing policies and rulemaking in areas with a relatively high concentration of enrollees than in other areas. Enrollees in these areas may also be more informed about covered and noncovered services available under Medicare. In some specifications of the regression model, the interaction of BENPOP and the year indicators DYR82-DYR86 is included as an indicator of PPS effects as discussed below.

PHYSPOP is the number of patient care doctors per capita in an area. It is a crude measure of the extent of competition among physicians in an area. The value of PHYSPOP is unavailable for the years 1984 through 1986. For each of these years, PHYSPOP retains its 1983 value for the years 1984 through 1986. In addition, the variable PHYSPOP# is defined to take on the 1983 value of PHYSPOP in 1984, 1985, and 1986, and is zero otherwise. PHYSPOP# (and other such variables defined below) appears in the regression equations as a means of protecting the variable PHYSPOP itself from bias induced by errors of measurement variables that are missing for particular years.

HMOPOP is the number of HMO enrollees per 100 population in an area. It is included as a covariate in the regression equations estimated here, but its measured effects must be interpreted with caution. While HMO growth may affect the level of utilization and medical cost in an area, HMOs thenselves are most likely to appear and flourish in areas with relatively high levels of medical cost. The coefficient of HMOPOP may therefore be regarded as a blend of causes and effects and cannot, in general, be interpreted as showing the effect of changes in HMO membership on utilization. HMOPOP is unavailable for 1986; for this year, HMOPOP takes on its 1985 value. The variable HMOPOP# takes on the 1985 value of HMOPOP in 1986 and is zero otherwise as described for the variable PHYSPOP#.

HBEDPOP is the number of hospital beds per capita population in the area. This variable may be regarded as a crude measure of the extent of hospital competition in the area; in the absence of a measure of the number of hospitals, however, its usefulness is limited. Numerous studies have documented a positive association between the availability of hospital beds in an area and hospital use (Roemer and Shain 1959; Newhouse and Phelps 1976; Ginsburg and Koretz 1983). HBEDPOP is missing for 1985 and 1986. The variable HBEDPOP# has been defined in the same manner as were PHYSPOP# and HMOPOP# above.

NBEDPOP is the number of nursing home beds per capita in the area. Since nursing home care is often a substitute for the last days of a hospital stay for many elderly patients, a negative association between hospital utilization and nursing home beds might be expected. This substitution can be quite difficult to measure empirically, since actual use of hospital versus nursing home care depends not only on availability of beds but also on the relative prices facing physicians and families. NBEDPOP is available only for 1981 and so takes on the same value for a given area in all years. The variable NBEDPOP# was created in the same way as HBEDPOP# above.

REGION2-REGION5 are regional indicator variables designed to control for gross differences in practice patterns among various areas of the country. While these variables are defined on the basis of specific BEAAs which do not follow state lines, the state composition of the areas is roughly as follows:

REGION2: VA, NC, SC, GA, FL ,AL, TN, KY, WV, AR, LA
REGION3: OH, MI, IN, IL, WI, IA, MO, OK, TX
REGION4: KS, NE, SD, ND, MT, WY, CO, NM, UT, ID
REGION5: AZ, NV, WA, OR, CA

3) Other Variables

Variable Names: WAIVER, MANY86

WAIVER is an indicator variable that takes on a value of one for areas in states that were granted waivers from the hospital payment rules of the Prospective Payment System (Maryland, Massachusetts, New Jersey, New York). For all other areas, WAIVER is set equal to zero. The double-difference estimator of PPS effects is derived using the coefficient of the interaction of the year indicators DYR82-DYR86 and (1-WAIVER), which equals one for nonwaivered states only.

MANY86 is an indicator variable set equal to one for areas of Massachusetts and New York for the year 1986 and is zero otherwise. Both states entered PPS in 1986. Redefining the value of WAIVER to equal zero in 1986 for these states would likely produce misleading results as argued in the last chapter. This variable is designed to capture changes in these states resulting from their entry to PPS and so mitigate bias in the coefficient of WAIVER.

The Base Model

The underlying regression model for empirical work performed in this paper can be expressed as

$$(5.1) \qquad y = X\beta + Z\theta + \varepsilon$$

where y is a measure of Part A utilization or payment, X is a vector of seasonal and market influences and the elements of Z are specified to capture PPS effects. Since the data used to estimate equation (1) are area-level (BEAA) means, observations are weighted by the square root of each area's Medicare Part A enrollment to correct for heteroscedasticity resulting from aggregation. Both weighted least squares (which assume that the disturbances are independent and identically distributed across areas and time periods) and fixed effect models (which assume that disturbances are composed of fixed area-specific and random components as outlined in the Appendix to Chapter V) have been estimated.

Specifying PPS Effects

We have already seen that no strict test for PPS effects can be constructed because of the nature of its implementation. All of the 'suggestive' tests used here rely heavily on identifying a particular period of time in which PPS effects appeared. Since there is no way of knowing when these effects emerged or the span of time in which adjustment occurred, two comparisons are made here--a comparison of utilization in 1984 with earlier utilization and a comparison of combined utilization in 1983 and 1984 with earlier utilization. The latter comparison is designed to reflect joint TEFRA/PPS effects; as a more encompassing measure, it is more likely to capture those effects of of PPS that were similar to aspects of TEFRA and also those anticipatory effects of PPS that occurred during the TEFRA year.

1. Pre-Post Estimates

The discussion of Chapter IV was based on the presumption that two years of data were available--one year of data prior to implementation of PPS (a "pre" year) and one year of data after implementation (a "post" year). The analytic datafile used in this study actually spans the six years from 1981 to 1986. Possession of additional years allows several forms of pre-post estimator to be calculated as outlined in the previous chapter. The simplest pre-post estimator presented in the last chapter measures differences in the level of utilization before and after implementation of PPS. It may be computed by specifying the vector Z in (1) as consisting of the year effects DYR82 through DYR86 in a regression equation estimated for nonwaivered states only:

$$y = X\beta + \sum_{i=82}^{86} \theta_i \mathrm{DYR}_i + \varepsilon \tag{5.2}$$

In light of the preceding discussion, Estimator 1 of PPS effects is given by θ_{84} and Estimator 2 is given by $\frac{1}{2}(\theta_{83} + \theta_{84})$. Estimators 3 and 4, the two second difference forms of the pre-post estimator, may be expressed as $(\theta_{84} - \theta_{82})$ and by $\{\frac{1}{2}(\theta_{83} + \theta_{84}) - \theta_{82}\}$, respectively.

Localities having a high concentration of Medicare enrollees might be expected to respond sooner or more strongly to the incentives created by PPS. To test for this outcome, the interactions of BENPOP (enrollees per 100 population) with the year indicators DYR82 through DYR86 were inserted into some specifications. The coefficients of this interaction term for the years 1982 and 1983 can be interpreted as reflecting PPS effects. The credibility of the pre-post estimators is clearly raised if these interactions have the same sign as the pre-post estimators.

All pre-post estimates are computed from a sample composed of BEAAs in non-waivered states in the years from 1981 through 1986. Separate equations were estimated for urban and rural areas.

2. Double-Difference Estimates

We have emphasized earlier that the double-difference estimators computed in this paper rely on the comparability of waivered and non-waivered states in terms of factors causing utilization to change over the period in which PPS was implemented. This is a strong assumption and requires that adjustments to prospective reimbursement programs in the waivered states were largely completed by 1983-1984. Since the state programs have undergone continuing modification since their inception, this assumption is surely not satisfied completely. Nevertheless, the double-difference estimator is likely to provide indications of PPS effects so long as these effects are stronger than the net effect of differences in other characteristics causing utilization to change in the two areas. Double-difference estimates are computed from the following respecification of the base model (5.2):

$$(5.3) \qquad y = X\beta + \sum_{i=82}^{86} \theta_i DYR_i + \sum_{82}^{86} \delta_i (1\text{-}WAIVER) DYR_i + \varepsilon$$

The double-difference estimator, specified in levels, is given by δ_{84} or by $\frac{1}{2}(\delta_{83} + \delta_{84})$. These estimators identify PPS effects with differences between PPS and waivered states in the change in utilization occurring in 1984 or in 1983-84. One can also compare these same differences for 1984 or 1983-84 with differences in 1982, resulting in the estimators $\delta_{84} - \delta_{82}$ and $\frac{1}{2}(\delta_{83} + \delta_{84}) - \delta_{82}$.

3. Summary of Estimators

For each measure of utilization, PPS effects are gauged using eight distinct estimators, as described in the previous chapter. Each of these estimators is itself a regression coefficient or a linear combination of coefficients, as specified above. Some estimators rely on the change in utilization in PPS or TEFRA/PPS years over the previous year. Others rely on the change in PPS or TEFRA/PPS years relative to the change in 1982 relative to 1981. The eight estimators are summarized in the table below:

EIGHT ESTIMATORS OF PPS EFFECT

Estimator	Type	Sample	Equation	Comparison
1. θ_{84}	Pre-post	Nonwaivered	5.2	A
2. $\frac{1}{2}(\theta_{83}+\theta_{84})$	Pre-post	Nonwaivered	5.2	B
3. $\theta_{84}-\theta_{82}$	Pre-post	Nonwaivered	5.2	C
4. $\frac{1}{2}(\theta_{83}+\theta_{84})-\theta_{82}$	Pre-post	Nonwaivered	5.2	D
5. δ_{84}	Dbl. Dif.	All	5.3	A
6. $\frac{1}{2}(\delta_{83}+\delta_{84})$	Dbl. Dif.	All	5.3	B
7. $\delta_{84}-\delta_{82}$	Dbl. Dif.	All	5.3	C
8. $\frac{1}{2}(\delta_{83}+\delta_{84})-\delta_{82}$	Dbl. Dif.	All	5.3	D

Comparisons

A: Increase (decrease) in 1984 over previous year
B: Increase in 1983/1984 over previous year
C: Increase in 1984 over increase in 1982
D: Increase in 1983/1984 over increase in 1982

Because of the heavy reliance on year effects or combinations of year effects to tease out PPS influences, it is unlikely that any of the estimators above is unbiased. The appendix to this chapter presents a fairly general model of utilization in waivered and nonwaivered states and displays the quantities actually incorporated in each of the estimators above.

OLS and Fixed-Effect Models

The regression results reported in Chapters VI and VII display OLS and fixed-effect estimates side by side. In all cases, fixed-effect estimates are used in the computation of Estimators 1 through 8 as defined above. As noted before, the fixed effect model estimated here yields estimates that are identical to those that would result from inserting a dummy variable for each of the 349 BEAA areas. The resulting "location-constant" estimates will give a more accurate picture of the true effects of changing local characteristics than will OLS.

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APPENDIX TO CHAPTER V

PPS Estimates and Year Effects

Assume for simplicity that PPS effects appear in 1984 and that adjustment is complete in that year. We express the regression equation for a generic utilization variable, y_t, in waivered states as

$$(5.A1) \qquad y_t = X_t\beta + \sum_{82}^{86} (\sigma_i + w_i)DYR_i + \varepsilon_t$$

and for nonwaivered states as

$$(5.A2) \qquad y_t = X_t\beta + \sum_{82}^{86} (\sigma_i + \alpha_i + \lambda_i)DYR_i + \varepsilon_t$$

where

σ_i	represents year effects common to waivered and nonwaivered states;
w_i	represents year effects specific to waivered states;
α_i	represents year effects specific to nonwaivered states;
λ_{84}	represents the effect of PPS, and $\lambda_i=0$ if $i\neq 84$.

Under these assumptions, the regression coefficient θ_i in equation (5.3) is an estimate of (σ_i+w_i), and the coefficient δ_i in (5.3) is an estimate of $(\lambda_i + \alpha_i - w_i)$. The coefficient θ_i in (5.2) is an estimate of $(\sigma_i + \alpha_i + \lambda_i)$.

Under the simplifying assumptions made here (that all PPS effects occur in 1984), the odd-numbered PPS estimates presented in the chapter are appropriate. The parameters actually estimated by each of these measures are shown below.

Estimator	Type	Parameters Estimated
1. θ_{84}	Pre-post	$\lambda_{84} + \sigma_{84} + \alpha_{84}$
3. $\theta_{84} - \theta_{82}$	Pre-post	$\lambda_{84} + (\sigma_{84} + \alpha_{84}) - (\sigma_{82} + \alpha_{82})$
5. δ_{84}	Dbl. Dif.	$\lambda_{84} + \alpha_{84} - w_{84}$
7. $\delta_{84} - \delta_{82}$	Dbl. Dif.	$\lambda_{84} + (\alpha_{84} - w_{84}) - (\alpha_{82} - w_{82})$

Clearly, none of these estimators captures the "pure" PPS effect, λ_{84}, unless the remaining parameters appearing in the third column of the table equal zero. Hence, for example, the double difference estimator δ_{84} is unbiased if $\alpha_{84} = w_{84}$, i.e., if year effects (other than PPS) specific to nonwaivered states are equal to year effects specific to waivered states. Which PPS estimator is best depends on which combinations of parameters (other than λ_{84}) appearing in the table is nearest to zero. Since the individual parameters $(\lambda, \delta, \alpha, w)$ are not estimable, the relative accuracy of the estimates cannot be judged a priori.

VI. HOSPITAL CARE

In the last chapter, alternative measures of PPS effects were derived. These included increments in utilization in 1984 or 1983/84 over the previous year and differences in increments in 1984 or 1983/84 over increments in 1982; they are referred to here as "pre-post" or "single-difference" estimators. Also included are deviations between nonwaivered and waivered states in each of the two sets of estimators; these are termed "double-difference" estimators. While none of these is likely to capture pure PPS effects, the range of estimates should provide reasonable bounds on the magnitude of immediate PSS effects. We have chosen to emphasize immediate effects because of the uncertainty about the span of time over which PPS effects have emerged. The choice of 1984 or 1983/84 as reference periods for the measurement of PPS effects was made in the belief that most of the behavioral responses occurred during this period and that measures based on a longer period would more likely be contaminated with extraneous effects.

Table 6.1 displays each of the eight measures of PPS effect on dimensions of hospital utilization by Medicare enrollees. The clearest results are for length of stay, for which all estimates show statistically significant declines of between three-tenths and nine-tenths of a day. Hospital days per enrollee per quarter are estimated to have declined by as much as one quarter of a day. Interpreting the results for hospital admissions and readmissions is more difficult. There is no evidence that hospital admissions have increased as a result of PPS, as was widely predicted several years ago, and there is some evidence that PPS has caused them to decline. This evidence is based on the pre-post estimates which reflect the experience of nonwaivered states only. The double-difference estimates, which rely on the comparison of changes in nonwaivered and waivered states, show no statistically significant effects, indicating that the admissions decline in nonwaivered states in the initial years of PPS was accompanied by a similar decline in waivered states. The time path of admissions from 1981 through 1986 is displayed in Figure 6.1. The largest four-quarter decline in admissions anywhere in the period occurred from the first through the fourth quarter of calendar 1984, for waivered and nonwaivered states alike. The decline may have been caused by some factor other than PPS, which affected both waivered and nonwaivered states. In this case, PPS may have had little or no effect on admissions as the double-difference estimates suggest. Alternatively, PPS may have caused a decline in admissions in nonwaivered states at the same time that other forces led to a parallel decline in waivered states.

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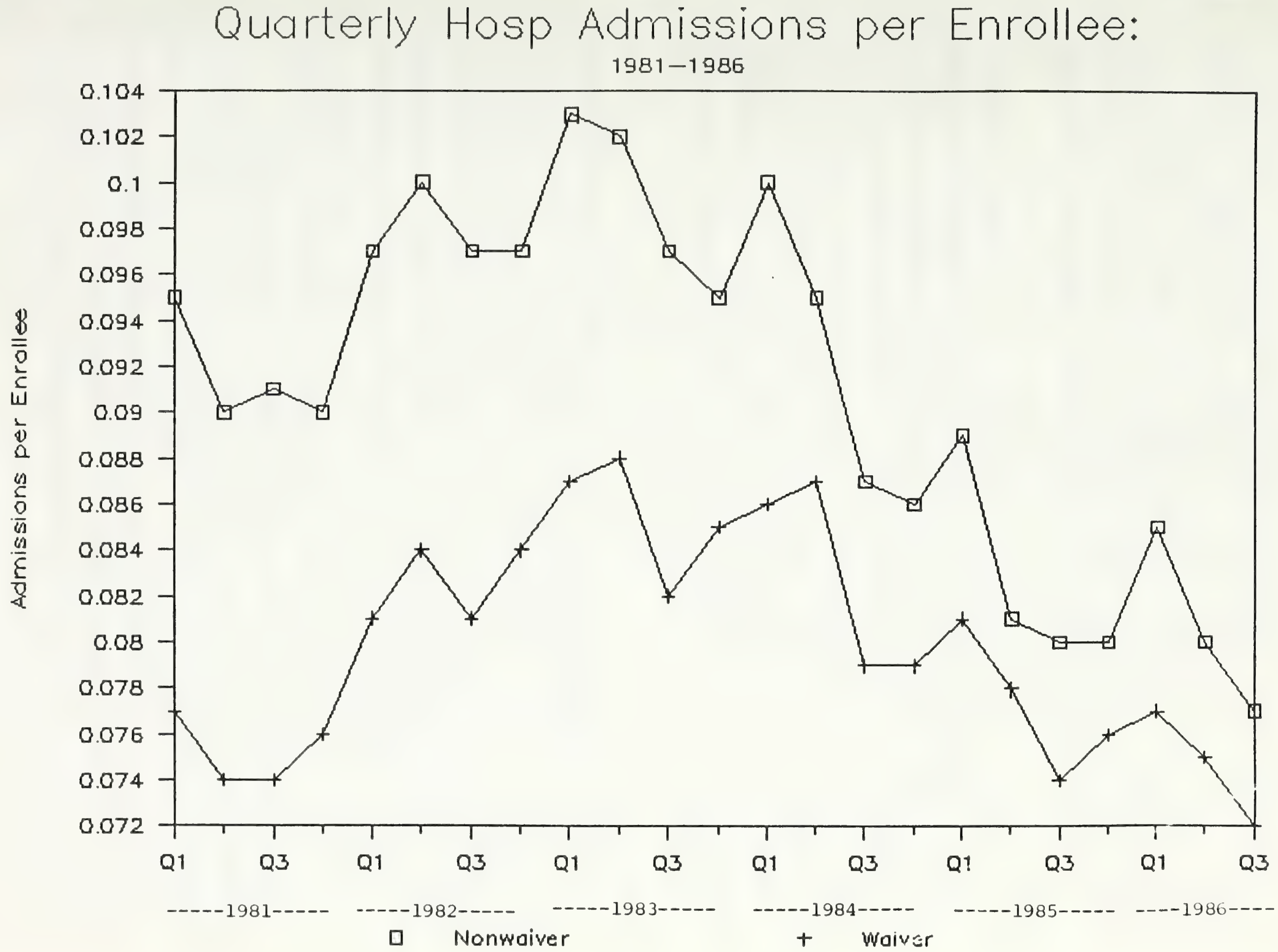
TABLE 6.1

REGRESSION ESTIMATES OF PPS EFFECTS ON HOSPITAL CARE

Pre-Post	Hospital Admissions per Enrollee-Qtr.	Hospital Length of Stay	Hospital Days per Enrollee-Qtr.	Rehospitalizations per Admission
Estimator 1	-0.0135**	-0.9193**	-0.2140**	-0.0050**
Estimator 2	-0.0061*	-0.6625**	-0.1206*	-0.0011*
Estimator 3	-0.0194**	-0.8448**	-0.2641**	-0.0136**
Estimator 4	-0.0120**	-0.5880**	-0.1702**	-0.0097**
Double Difference				
Estimator 5	-0.0011	-0.5220**	-0.0504**	+0.0044**
Estimator 6	-0.0112	-0.3145*	-0.0423**	+0.0007
Estimator 7	0.0000	-0.5504**	-0.0121	+0.0047**
Estimator 8	-0.0000	-0.3429**	-0.0040	+0.0010

---

*Estimate significant at 0.10 level (two-sided test).
**Estimate significant at 0.05 level (two-sided test).


Quarterly Hosp Admissions per Enrollee:
1981—1986
Admissions per Enrollee
0.104
0.102
0.1
0.098
0.096
0.094
0.092
0.09
0.088
0.086
0.084
0.082
0.08
0.078
0.076
0.074
0.072
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
-----1981-----
-----1982-----
-----1983-----
-----1984-----
-----1985-----
----1986----
□ Nonwaiver
+ Waiver

The results for rehospitalizations are similarly problematic. The pre-post measures indicate a PPS-induced decline in the 30-day rehospitalization rate ranging from one per thousand to 13 per thousand. The double-difference estimates, on the other hand, show that the rehospitalization rate in PPS states increased by about four per thousand relative to changes experienced in the waivered states. For both admissions and rehospitalizations, then, the double-difference measures yield estimates that are closer to those expected on the basis of hospital incentives engendered by prospective payment.

Tables 6.2-6.9 present full regression estimates for the OLS and fixed-effect models of Medicare hospital admissions, length of stay, days per enrollee and rehospitalizations per hospital admission. Each model is estimated for nonwaivered states only and for waivered and nonwaivered states combined. The PPS estimates reported in Table 6.1 were developed using the fixed-effect specifications for combined urban and rural areas. The pre-post estimates were computed on the basis of the coefficients of DYR82, DYR83 and DYR84, double-difference estimates used coefficients of (1-WAIVER)DYR82 through (1-WAIVER)DYR84, as outlined in Chapter 5. In discussing the regression estimates, coefficients will be referred to using the name of the associated variable.

Hospital Admissions

Even a casual examination of Table 6.2 makes clear why the pre-post estimator showed negative effects of PPS on admissions. Examination of the variables DYR82 through DYR86 shows a consistent, statistically significant rise in admissions in nonwaivered states for the years 1982 and 1983 and a consistent, statistically significant decline in admissions for each of the years from 1984 through 1986. It is hard to avoid the conclusion that something happened in 1984 that started the decline in admissions in these states. Since implementation of PPS was unquestionably the salient event affecting hospitals in that year, it is natural to further conclude that PPS caused (or at least initiated) the decline. The nonwaivered state-year interactions (i.e., the interactions of [1-WAIVER] and DYR82 through DYR 86) shown in Table 6.3 indicate that admissions had been falling in nonwaivered states relative to waivered states throughout the period 1982-1986, generally by statistically insignificant amounts, the year 1985 being the obvious exception. For this reason, the double-difference estimates, which rely on a comparison of nonwaivered and waivered states, are quite small in absolute value and do not attain statistical significance, while the pre-post estimators do. The weight of the evidence, then, suggests that PPS has caused hospital admission rates to fall, even though the existence of some other influence causing admissions to fall in both waivered and nonwaivered states cannot be ruled out.

The marked seasonal and regional variation in admissions per enrollee is evident from inspection of the values of the relevant indicator variables in Tables 6.2 and 6.3. This region-to-region and season-to-season variation is clearly more extreme in rural areas as shown by the greater range of values of the season and region variables.

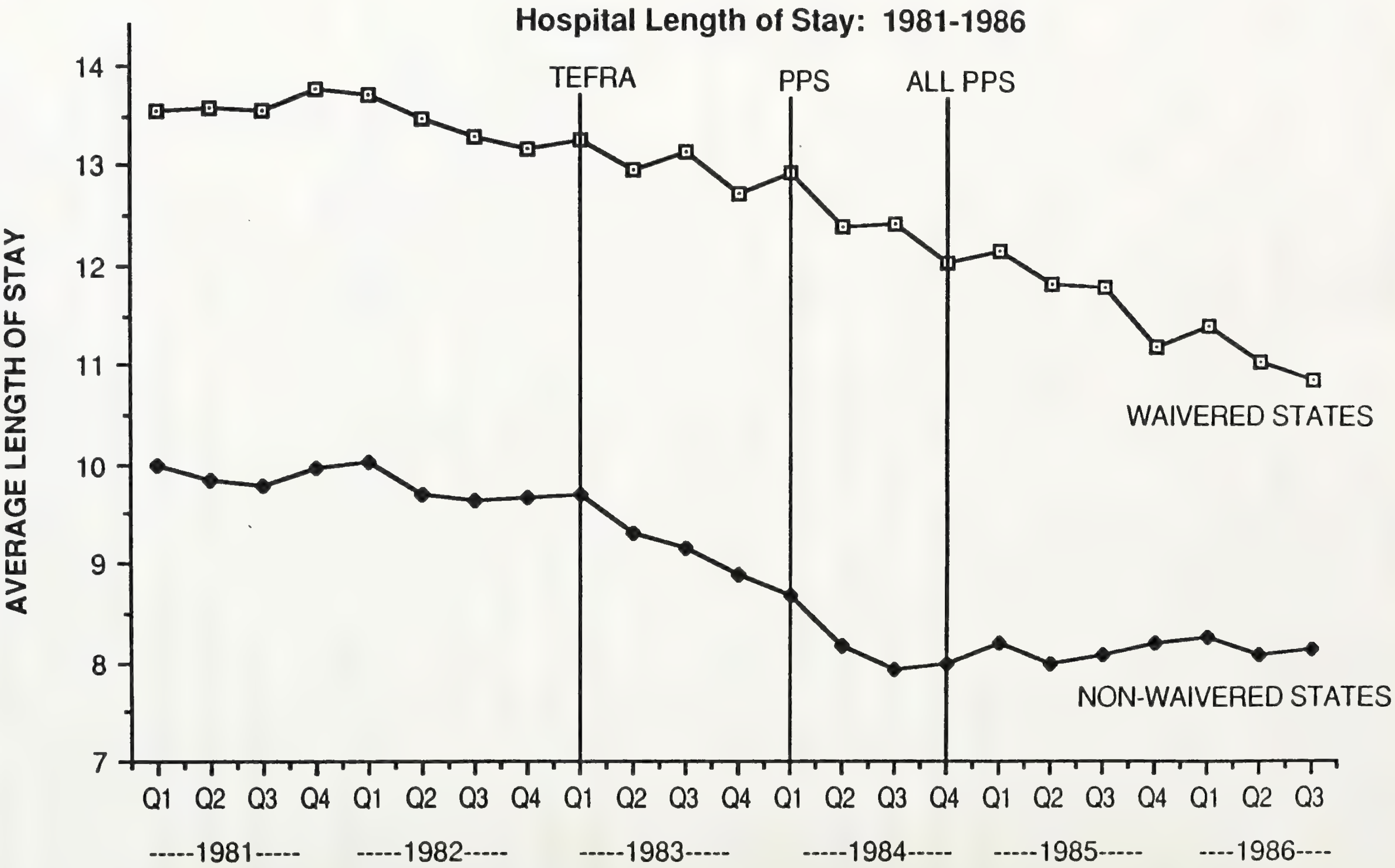
In earlier chapters, we argued that the fixed-effect model is likely to produce a more accurate picture of the effect of market characteristics on utilization of health care. Fixed-effect estimates are far less sensitive to long term adjustment of market variables to prevailing levels of utilization in an area than are OLS estimates, and so will reflect more accurately the direct influence of these variables on utilization itself.

Bearing that argument in mind, it is instructive to compare the two estimates of the effect of market variables. Note especially that while the OLS estimates of the effects of beneficiaries per 100 population (BENPOP) and physicians per capita (PHYSPOP) are uniformly negative, the fixed-effect estimates reveal that when area is held constant, increases in either of these variables are associated with increases in hospital admissions per enrollee. The effect of hospital beds per capita, on the other hand, appears to be accurately estimated by OLS. (Fixed-effect estimates of the effect of nursing home beds per capital could not be computed, since only one year of data was available for this variable.) Fixed-effect estimates do indicate that increases in HMO enrollees per 100 population produce a decline in admissions per enrollee among the urban Medicare population. Only a very small fraction of enrollees could have been enrolled in HMOs in the period under study here. Therefore, the negative estimate suggests that HMO growth may change practice patterns broadly and in ways that affect the treatment of all patients in a community, not just HMO enrollees.

Hospital Length of Stay

Regression results for length of stay are shown in Tables 6.4 and 6.5. Even though the PPS effects were uniformly estimated to be negative in Table 6.1, the year effects and nonwaivered state-year interactions for the years 1985 and 1986 indicate that the long-run effects of PPS on length of stay may be somewhat smaller than the immediate effects. The signs of DYR85 and DYR86 in Table 6.4 are generally positive, as are the signs of (1-WAIVER)DYR85 and (1-WAIVER)DYR86 in Table 6.5. Length of stay is thus estimated to have increased in 1985 and 1986, both absolutely and in comparison to waivered states, a trend clearly visible in Figure 6.2. It is possible that

Figure 6.2



Hospital Length of Stay: 1981-1986

hospitals overreacted to prospective payment in setting discharge policies and that subsequent readjustments increased the mean length of stay. A continuing decline in admissions would be expected to result in a relatively sicker hospital population and so in some increase in length of stay. However, attempts to account for the rise in length of stay by adding an area-level CMI measure to the regression equations of Tables 6.4 and 6.5 were unsuccessful.

Seasonal variation is clearly less pronounced for length of stay than for hospital admissions, and the variability is similar for urban and rural hospitals. Regional variation is marked, however, with a difference of roughly two days between the northeastern U.S. (the omitted region) and the west-northwest (REGION 5).

Once again, remarkable differences emerge between the OLS and fixed-effect models. Increases in physicians per capita tend to reduce Medicare lengths of stay, contrary to the OLS results. Increases in hospital beds per capita tend to raise lengths of stay, though sometimes by insignificant amounts. Growth in HMO membership appears to have a clear negative effect on Medicare length of stay. Finally, as Medicare beneficiaries grow relative to the population, length of hospital stay for these beneficiaries seems to fall; OLS underestimates this relationship by an order of magnitude.

Hospital Days Per Enrollee

In 1985 hospital days per enrollee rose in nonwaivered states relative to waivered states, as seen by the sign of (1-WAIVER)DYR85 in Table 6.7. The magnitude of this rise was of the same order as the two statistically significant double-difference estimates of PPS effect on days per enrollee reported in Table 6.1. In the same manner as for length of stay, then, there is some evidence that the PPS-induced decline in hospital days was short-lived. The nonwaiver-only results do not confirm this result. The fixed-effect estimate of DYR85 is positive only for urban areas in Table 6.6 and is much smaller in magnitude than the pre-post measures of PPS effect as shown in Table 6.1.

The fixed-effect estimates of Tables 6.6 and 6.7 clearly show that growth in Medicare enrollees and HMO membership, relative to the population, both reduce Medicare hospital days per enrollee, whereas increases in hospital beds per capita tend to increase Medicare hospital days. Furthermore, according to the fixed-effect estimates, there is no significant relationship between physicians per capita and hospital days per enrollee.

Rehospitalizations

The estimates of Table 6.1 provide little guidance in assessing the effect of PPS on rehospitalizations. Depending on the estimator chosen, one could argue that rehospitalizations have increased, decreased or remained unchanged as a result of PPS. A careful examination of Tables 6.8 and 6.9 helps to clarify the underlying trends in rehospitalization rates that produce these diverse results. The fixed-effect coefficients DYR82 through DYR85 in both tables show that rehospitalization rates increased uniformly in the 1981-1985 period (in both urban and rural areas) except for 1984, when rehospitalizations per hospitalized enrollee declined. Over the same period, however, rehospitalizations in nonwaiver states were decreasing relative to rehospitalizations in waiver states, except for 1984, when rehospitalizations rose in nonwaiver states relative to waiver states. (See the coefficients (1-WAIVER)DYR82 through (1-WAIVER)DYR85 in Table 6.9.) The pre-post estimators then capture the negative interruption to the absolute trend as a negative effect of PPS on rehospitalizations while the double-difference estimators capture the positive interruption to the relative trend as a positive PPS effect. On balance there seems no compelling evidence that PPS has affected the long-run proportion of Medicare enrollees who are rehospitalized within 30 days of an initial hospital admission.

The likelihood of rehospitalization does seem to increase with HMO membership relative to the population and with hospital beds per capita in urban areas. Increases in the physician-to-population ratio seem to result in an increased rate of rehospitalization (at least in the fixed-effects model), though statistical significance of this estimate apparently cannot be established with the smaller sample sizes of the separate urban and rural models.

As a final observation, note that rehospitalizations are greatest in Region 5, which exhibited the lowest levels for hospital length of stay and days per enrollee.

TABLE 6.2

QUARTERLY MEDICARE HOSPITAL ADMISSIONS PER ENROLLEE
Nonwaivered States Only

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.1001 (86.9)	0.0907 (56.0)	0.1085 (59.5)			
URBAN	-0.0096 (-25.6)					
SPRING	-0.0036 (-11.0)	-0.0032 (-8.2)	-0.0045 (-8.4)	-0.0036 (-17.5)	-0.0032 (-12.0)	-0.0045 (-13.6)
SUMMER	-0.0067 (-20.3)	-0.0056 (-14.2)	-0.0089 (-16.8)	-0.0067 (-32.3)	-0.0056 (-20.9)	-0.0089 (-27.2)
AUTUMN	-0.0075 (-21.4)	-0.0059 (-14.0)	-0.0108 (-19.0)	-0.0075 (-34.1)	-0.0059 (-20.7)	-0.0108 (-30.9)
REGION2	0.0122 (19.5)	0.0047 (5.2)	0.0160 (20.0)			
REGION3	0.0068 (14.7)	0.0039 (6.5)	0.0096 (13.9)			
REGION4	-0.0040 (-7.8)	-0.0054 (-7.1)	-0.0039 (-5.7)			
REGIONS5	-0.0053 (-11.8)	-0.0038 (-7.3)	-0.0104 (-12.0)			
AUT86DUM	-0.0057 (-8.1)	-0.0065 (-7.7)	-0.0042 (-3.7)	-0.0057 (12.9)	-0.0065 (-11.4)	-0.0042 (-6.0)
DYR82	0.0083 (10.2)	0.0010 (5.8)	0.0095 (7.2)	0.0059 (21.2)	0.0053 (12.6)	0.0066 (15.7)
DYR83	0.0020 (4.8)	0.0022 (4.6)	0.0014 (2.2)	0.0013 (4.9)	0.0013 (3.5)	0.0011 (2.6)
DYR84	-0.0137 (-18.4)	-0.0105 (-8.7)	-0.0122 (-9.5)	-0.0135 (-28.6)	-0.0099 (-11.7)	-0.0138 (-17.2)
DYR85	-0.0066 (-5.7)	-0.0049 (-3.0)	-0.0060 (-3.7)	-0.0059 (-8.1)	-0.0041 (-3.7)	-0.0053 (-5.1)
DYR86	-0.0024 (-5.6)	-0.0021 (-3.9)	-0.0031 (-4.4)	-0.0027 (-9.6)	-0.0023 (-6.5)	-0.0033 (-7.5)
BENPOP	-0.0004 (-7.8)	-0.0005 (-9.3)	-0.0005 (-5.3)	0.0014 (3.8)	0.0016 (3.2)	0.0008 (1.4)
HBEDPOP	5.1740 (35.4)	4.979 (27.1)	6.1185 (27.0)	5.5869 (8.2)	6.2356 (6.5)	3.5779 (3.7)
HBEDPOP#	-0.7527 (-3.5)	-0.7300 (-2.7)	-1.3424 (-4.0)	-0.9850 (-7.3)	-0.9892 (-5.2)	-1.5273 (-7.3)
PHYSPOP	-10.9991 (-30.2)	-7.8479 (-17.6)	-21.5180 (-21.7)	3.8704 (2.6)	8.7963 (2.5)	1.9329 (1.3)
PHYSPOP#	4.4393 (11.2)	2.6662 (4.6)	3.4451 (2.7)	4.2988 (16.8)	2.4634 (6.2)	5.0475 (6.3)

TABLE 6.2 (continued)

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0001	0.0004	0.0003	0.00004	-0.0001	-0.00003
	(4.2)	(1.4)	(4.7)	(0.7)	(-1.7)	(-0.1)
HMOPOP#	0.00003	-0.00005	0.0001	0.00007	0.000005	0.0001
	(0.8)	(-1.1)	(1.1)	(2.8)	(0.2)	(1.9)
NBEDPOP	-0.2858	-0.9017	-0.3709			
	(-2.8)	(-5.2)	(-2.8)			
NBEDPOP#	-0.2027	-0.0655	-0.2043			
	(-1.9)	(-0.3)	(-1.5)			
R^2	0.62	0.57	0.61	0.86	0.81	0.86
N	7896	3768	4128	7896	3768	4128

TABLE 6.3

QUARTERLY MEDICARE HOSPITAL ADMISSIONS PER ENROLLEE
Waivered and Nonwaivered States

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.1000	0.0898	0.1087			
	(87.3)	(55.7)	(61.5)			
URBAN	-0.0101					
	(-27.6)					
SPRING	-0.0031	-0.0026	-0.0043	-0.0031	-0.0026	-0.0043
	(-10.1)	(-7.2)	(-8.4)	(-16.5)	(-11.0)	(-13.6)
SUMMER	-0.0063	-0.0053	-0.0088	-0.0063	-0.0053	-0.0088
	(-20.5)	(-14.6)	(-17.1)	(-33.5)	(-22.4)	(-27.7)
AUTUMN	-0.0068	-0.0052	-0.0105	-0.0068	-0.0052	-0.0105
	(-20.5)	(-13.3)	(-19.2)	(-33.4)	(-20.4)	(-31.1)
REGION2	0.0063	0.0009	0.0151			
	(13.2)	(1.5)	(20.2)			
REGION3	0.0061	0.0036	0.0092			
	(12.8)	(5.7)	(14.0)			
REGION4	-0.0047	-0.0058	-0.0040			
	(-9.0)	(-7.3)	(-6.0)			
REGION5	-0.0056	-0.0038	-0.0103			
	(-12.2)	(-7.2)	(-12.1)			
AUT86DUM	-0.0063	-0.0071	-0.0045	-0.0063	-0.0071	-0.0045
	(-9.5)	(-9.1)	(-4.1)	(-15.5)	(-13.9)	(-6.6)
DYR82	0.0100	0.0090	0.0079	0.0070	0.0068	0.0057
	(8.6)	(5.9)	(2.6)	(11.4)	(8.8)	(3.2)
DYR83	0.0035	0.0033	0.0087	0.0025	0.0023	0.0034
	(3.6)	(3.3)	(1.6)	(4.2)	(3.4)	(1.9)
DYR84	-0.0125	-0.0089	-0.0098	-0.0125	-0.0088	-0.0109
	(-9.6)	(-5.3)	(-3.0)	(-15.6)	(-7.8)	(-5.4)
DYR85	-0.0031	-0.0027	-0.0009	-0.0024	-0.0014	-0.0004
	(-2.2)	(-1.6)	(-0.3)	(-2.7)	(-1.2)	(-0.2)
DYR86	0.0040	-0.0011	-0.0078	-0.0022	-0.0024	-0.0015
	(-2.8)	(-0.8)	(-1.2)	(-2.4)	(-2.5)	(-0.3)
BENPOP	-0.0005	-0.0006	-0.0005	0.0012	0.0011	0.0009
	(-10.4)	(-10.5)	(-6.2)	(3.3)	(2.3)	(1.6)
HBEDPOP	5.0307	4.8011	6.1789	5.1637	6.0263	3.2000
	(34.8)	(26.0)	(28.5)	(8.0)	(6.6)	(3.6)
HBEDPOP#	-0.7434	-0.6693	-1.3769	-0.9668	-0.9865	-1.5161
	(-3.5)	(-2.4)	(-4.2)	(-7.3)	(-5.3)	(-7.4)
PHYSPOP	-9.8548	-7.4276	-21.5496	3.7324	7.1621	1.9800
	(-28.2)	(-17.0)	(-22.6)	(2.6)	(2.1)	(1.3)
PHYSPOP#	4.3553	2.8086	3.4801	4.3519	2.8066	4.7974
	(11.4)	(5.1)	(2.8)	(18.2)	(7.5)	(6.2)

TABLE 6.3 (continued)

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.00007	0.00002	0.0003	0.000001	-0.0001	0.00002
	(2.4)	(0.8)	(4.6)	(0.03)	(-2.0)	(0.1)
HMOPOP#	0.00004	-0.00003	0.0001	0.00006	-0.000008	0.0001
	(1.1)	(-0.7)	(1.1)	(2.7)	(-0.3)	(2.1)
NBEDPOP	-0.1023	-0.5886	-0.3624			
	(-1.0)	(-3.5)	(-2.8)			
NBEDPOP#	-0.1987	-0.0328	-0.2021			
	(-1.9)	(-0.2)	(-1.5)			
WAIVER	-0.0081	-0.0071	-0.0078			
	(-10.3)	(-8.2)	(-3.6)			
MANY86	0.0013	-0.0022	0.0020	-0.0015	-0.0006	-0.0052
	(0.9)	(-1.4)	(0.3)	(-1.6)	(-0.5)	(-1.2)
(1-WAIVER)DYR82	-0.0018	-0.0022	0.0015	-0.0011	-0.0013	-0.0008
	(-1.7)	(-1.9)	(0.5)	(-1.7)	(-1.8)	(0.4)
(1-WAIVER)DYR83	-0.0015	-0.0010	-0.0032	-0.0012	-0.0009	-0.0023
	(-1.4)	(-0.9)	(-1.1)	(-1.8)	(-1.2)	(-1.3)
(1-WAIVER)DYR84	-0.0010	-0.0018	-0.0025	-0.0011	-0.0018	-0.0028
	(-0.9)	(-1.6)	(-0.8)	(-1.6)	(-2.3)	(-1.5)
(1-WAIVER)DYR85	-0.0035	-0.0026	-0.0049	-0.0035	-0.0024	-0.0050
	(-3.4)	(-2.3)	(-1.7)	(-5.6)	(-3.4)	(-2.8)
(1-WAIVER)DYR86	0.0017	-0.0008	0.0048	-0.0032	0.0003	-0.0018
	(1.2)	(-0.5)	(0.7)	(-0.3)	(0.3)	(-0.4)
R^2	0.63	0.57	0.62	0.87	0.82	0.86
N	8376	4032	4344	8376	4032	4344

TABLE 6.4

MEDICARE LENGTH OF STAY
Nonwaivered States Only

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	9.8187 (109.5)	10.8472 (67.4)	9.7968 (93.3)			
URBAN	0.7095 (24.3)					
SPRING	-0.3011 (-11.7)	-0.2870 (-7.4)	-0.3291 (-10.7)	-0.3011 (-23.4)	-0.2870 (-15.5)	-0.3291 (-18.8)
SUMMER	-0.3545 (-13.8)	-0.3441 (-8.8)	-0.3751 (-12.2)	-0.3545 (-27.5)	-0.3441 (-18.6)	-0.3751 (-21.4)
AUTUMN	-0.3567 (-13.0)	-0.3598 (-8.6)	-0.3507 (-10.7)	-0.3567 (-25.9)	-0.3598 (-18.2)	-0.3507 (-18.7)
REGION2	-0.9619 (-19.7)	-1.1599 (-12.8)	-0.7864 (-17.1)			
REGION3	-0.9790 (-27.0)	-1.1779 (-19.5)	-0.8016 (-20.8)			
REGION4	-1.3191 (-32.8)	-1.7096 (-22.6)	-1.0708 (-27.5)			
REGION5	-1.9228 (-54.9)	-2.0609 (-40.0)	-1.7857 (-35.8)			
AUT86DUM	-0.4956 (-9.0)	-0.5692 (-6.8)	-0.3471 (-5.2)	-0.4956 (-17.9)	-0.5692 (-14.4)	-0.3471 (-9.2)
DYR82	-0.0343 (-0.5)	0.1787 (1.5)	-0.0206 (0.3)	-0.0745 (-4.3)	-0.0284 (-1.0)	-0.1018 (-4.5)
DYR83	-0.5139 (-16.1)	-0.5476 (-11.3)	-0.4410 (-11.6)	-0.4057 (-24.4)	-0.3807 (-14.3)	-0.4035 (-18.4)
DYR84	-0.8420 (-14.5)	-0.8636 (-7.2)	-1.0719 (-14.4)	-0.9193 (-31.3)	-0.8146 (-13.8)	-1.0681 (-24.8)
DYR85	-0.1813 (-2.0)	0.2695 (1.7)	0.0216 (0.2)	0.3365 (7.4)	0.4794 (6.3)	0.1593 (2.8)
DYR86	0.0159 (0.5)	-0.0046 (-0.1)	0.0596 (1.5)	0.0790 (4.6)	0.0603 (2.4)	0.1047 (4.4)
BENPOP	-0.0301 (-8.2)	-0.0429 (-7.8)	-0.0290 (-5.2)	-0.4614 (-20.4)	-0.5939 (-17.4)	-0.2523 (-8.5)
HBEDPOP	-81.1160 (-7.1)	-104.100 (-5.7)	-65.6245 (-5.0)	45.1402 (1.06)	-0.9353 (-0.01)	104.100 (2.0)
HBEDPOP#	-54.6537 (-3.3)	-67.3837 (-2.5)	-25.5285 (-1.3)	-53.7036 (-6.4)	-60.6492 (-4.6)	-42.9006 (-3.8)
NBEDPOP	28.0678 (3.6)	36.6947 (2.1)	27.4334 (3.17)			
NBEDPOP#	-22.4298 (-2.7)	-64.3733 (-3.4)	-15.194 (-2.0)			

TABLE 6.4 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
PHYSPOP	694.935 (24.5)	701.301 (15.8)	422.869 (7.4)	-206.2089 (-2.3)	-630.173 (-2.6)	-87.292 (-1.1)
PHYSPOP#	-127.654 (-4.1)	-105.101 (-1.8)	88.0840 (1.2)	-20.0891 (-1.3)	-72.6509 (-2.6)	137.255 (3.2)
HMOPOP	-0.0163 (-7.2)	-0.0189 (0.7)	0.0060 (1.4)	-0.0630 (-17.5)	-0.06119 (-13.5)	-0.0991 (-5.2)
HMOPOP#	0.0034 (1.3)	0.0030 (0.7)	0.0005 (0.1)	0.0008 (0.5)	-0.0040 (-1.9)	0.0075 (2.1)
R^2	0.70	0.67	0.64	0.93	0.93	0.89
N	7896	3768	4128	7896	3768	4128

NOTE: T values appear in parentheses. All estimates are weighted by the square root of Part A Aged enrollment.

TABLE 6.5

MEDICARE LENGTH OF STAY
Waivered and Nonwaivered States

	--------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	9.6614 (97.2)	10.5769 (59.9)	10.0956 (91.8)			
URBAN	0.6884 (21.7)					
SPRING	-0.3003 (-11.3)	-0.2889 (-7.2)	-0.3276 (-10.3)	-0.3003 (-22.7)	-0.2889 (-15.3)	-0.3276 (-18.1)
SUMMER	-0.3511 (-13.2)	-0.3406 (-8.5)	-0.3763 (-11.8)	-0.3511 (-26.6)	-0.3406 (-18.0)	-0.3763 (-20.8)
AUTUMN	-0.3914 (-13.7)	-0.4006 (-9.4)	-0.3694 (-10.9)	-0.3914 (-27.7)	-0.4006 (-19.9)	-0.3694 (-19.1)
REGION2	-0.9947 (-24.2)	-1.1197 (-17.5)	-0.8295 (-17.1)			
REGION3	-0.9312 (-22.8)	-1.0967 (-15.9)	-0.8339 (-20.3)			
REGION4	-1.3150 (-29.1)	-1.6460 (-19.0)	-1.1310 (-27.4)			
REGION5	-1.8546 (-47.4)	-1.9851 (-34.2)	-1.7181 (-32.5)			
AUT86DUM	-0.6760 (-11.8)	-0.7913 (-9.2)	-0.3988 (-5.8)	-0.6760 (-23.8)	-0.7913 (-19.5)	-0.3988 (-10.2)
DYR82	-0.1510 (-1.5)	-0.0848 (0.5)	-0.4345 (-2.3)	-0.1090 (-2.6)	-0.0086 (-0.1)	-0.4547 (-4.4)
DYR83	-0.4163 (-5.1)	-0.4164 (-3.8)	-0.4116 (-2.3)	-0.3103 (-7.5)	-0.2742 (-5.0)	-0.3387 (-3.3)
DYR84	-0.2549 (-2.3)	-0.2409 (-1.3)	-0.5755 (-2.9)	-0.3214 (-5.7)	-0.1615 (-1.8)	-0.5411 (-4.7)
DYR85	-0.3527 (-2.8)	-0.2485 (-1.3)	-0.5568 (-2.8)	-0.3064 (-5.0)	-0.2341 (-2.6)	-0.4734 (-4.1)
DYR86	-0.5310 (-4.4)	-0.4580 (-2.9)	-1.9398 (-4.9)	-0.0696 (1.1)	-0.1120 (1.5)	-0.2040 (-18.1)
BENPOP	-0.0228 (-5.6)	-0.0262 (-4.2)	-0.0527 (-10.1)	-0.4340 (-17.9)	-0.5391 (-14.6)	-0.2610 (-8.5)
HBEDPOP	-21.9833 (-1.8)	-30.4552 (-1.5)	-25.7813 (-1.9)	92.9872 (2.1)	70.0680 (1.0)	123.811 (2.5)
HBEDPOP#	-72.45 (-3.9)	-92.9014 (-3.0)	-31.0982 (-1.5)	-59.5531 (-6.5)	-65.6674 (-4.5)	-37.0677 (-3.2)
PHYSPOP	654.803 (21.7)	676.047 (14.1)	255.540 (4.3)	-188.8769 (-1.9)	-649.4031 (-2.4)	-80.7872 (-0.9)
PHYSPOP#	-129.062 (-3.9)	-134.349 (-2.2)	122.164 (1.6)	-78.0191 (-4.7)	-145.540 (-4.9)	134.223 (3.0)

TABLE 6.5 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	-0.0159 (-6.4)	-0.0166 (-4.7)	0.0070 (1.6)	-0.0465 (-12.3)	-0.0461 (-9.5)	-0.0465 (-2.7)
HMOPOP#	0.0020 (0.7)	0.0010 (0.2)	-0.0021 (-0.4)	0.0023 (1.4)	-0.0009 (-0.4)	0.0038 (1.0)
NBEDPOP	5.5428 (0.6)	-10.2673 (-0.6)	28.5287 (3.6)			
NBEDPOP#	-20.5051 (-2.3)	-54.7570 (-2.7)	-14.6502 (-1.8)			
WAIVER	2.8469 (41.8)	2.7659 (29.3)	3.3341 (24.8)			
MANY86	-0.6216 (-4.9)	-0.6942 (-4.1)	0.9433 (2.4)	-1.4290 (-21.1)	-1.4672 (-17.4)	-0.9748 (-3.9)
(1-WAIVER)DYR82	0.1058 (1.2)	0.0383 (0.3)	0.4192 (2.2)	0.0284 (0.6)	-0.0264 (-0.4)	0.3510 (3.3)
(1-WAIVER)DYR83	-0.0954 (-1.1)	-0.1311 (-1.1)	-0.0245 (-0.1)	-0.1071 (-2.4)	-0.1215 (-2.1)	-0.0690 (-0.7)
(1-WAIVER)DYR84	-0.5816 (-6.3)	-0.5655 (-4.5)	-0.5216 (-2.8)	-0.5220 (-11.3)	-0.5333 (-9.0)	-0.5299 (-5.0)
(1-WAIVER)DYR85	0.6252 (7.0)	0.6518 (5.4)	0.6112 (3.4)	0.6290 (14.3)	0.6653 (11.7)	0.5984 (5.8)
(1-WAIVER)DYR86	0.5906 (4.7)	0.5066 (3.1)	2.0175 (5.0)	0.0522 (0.8)	-0.0006 (-0.0)	0.3243 (1.3)
R^2	0.82	0.80	0.71	0.96	0.96	0.91
N	8376	4032	4344	8376	4032	4344

TABLE 6.6

QUARTERLY HOSPITAL DAYS PER ENROLLEE
Nonwaivered States Only

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.9597 (76.7)	0.9673 (47.1)	1.0455 (61.8)			
URBAN	-0.0163 (-4.0)					
SPRING	-0.0585 (-16.3)	-0.0529 (-10.7)	-0.0696 (-14.1)	-0.0585 (-27.5)	-0.0529 (-18.3)	-0.0696 (-22.2)
SUMMER	-0.0903 (-25.2)	-0.0801 (-16.1)	-0.1107 (-22.4)	-0.0903 (-42.5)	-0.0801 (-27.7)	-0.1107 (-35.3)
AUTUMN	-0.0982 (-25.6)	-0.0852 (-16.0)	-0.1240 (-23.5)	-0.0982 (-43.3)	-0.0852 (-14.5)	-0.1240 (-37.1)
REGION2	0.0049 (0.7)	-0.0654 (-5.7)	0.0429 (5.8)			
REGION3	-0.0298 (-5.9)	-0.0635 (-8.2)	-0.0060 (-1.0)			
REGION4	-0.1484 (-26.5)	-0.1836 (-19.0)	-0.1301 (-20.7)			
REGION5	-0.2041 (-41.8)	-0.2009 (-30.6)	-0.2339 (-29.1)			
AUT86DUM	-0.0770 (-10.0)	-0.0899 (-8.4)	-0.0514 (-4.8)	-0.0770 (-16.9)	-0.0899 (-14.5)	-0.0514 (-7.6)
DYR82	0.0784 (8.8)	0.0799 (5.2)	0.0794 (6.5)	0.0500 (17.6)	0.0519 (11.4)	0.0468 (11.7)
DYR83	-0.0295 (-6.6)	-0.0270 (-4.4)	-0.0337 (-5.5)	-0.0268 (-9.6)	-0.0209 (-5.0)	-0.0349 (-8.9)
DYR84	-0.2079 (-25.6)	-0.1781 (-11.6)	-0.2292 (-19.1)	-0.2140 (-44.1)	-0.1667 (-18.1)	-0.2399 (-31.1)
DYR85	-0.0171 (-1.3)	0.0008 (0.0)	-0.0359 (-2.4)	0.0028 (0.4)	0.0277 (2.3)	-0.0247 (-2.5)
DYR86	-0.0161 (-3.4)	-0.0162 (-2.5)	-0.0155 (-2.4)	-0.0132 (-4.6)	-0.0126 (-3.3)	-0.0151 (-3.5)
BENPOP	-0.0059 (-11.6)	-0.0082 (-11.7)	-0.0062 (-7.5)	-0.0256 (-6.9)	-0.0403 (-7.5)	-0.0073 (-1.4)
HBEDPOP	40.8078 (25.7)	40.5121 (17.4)	43.4055 (20.7)	47.6917 (6.8)	54.5040 (5.2)	33.3921 (3.6)
HBEDPOP#	-16.5895 (-7.1)	-18.0770 (-5.2)	-14.9305 (-4.8)	-18.6261 (-13.5)	-19.7340 (-9.6)	-17.1030 (-8.5)
PHYSPOP	-39.1566 (-9.9)	-15.800 (-2.8)	-143.558 (-15.6)	21.0039 (1.4)	39.7631 (1.0)	2.5272 (0.2)
PHYSPOP#	32.9573 (7.6)	17.7743 (2.4)	58.303 (5.0)	41.7375 (15.9)	18.0866 (4.2)	71.1069 (9.3)

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED MORTALITY

TABLE 6.6 (continued)

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	-0.0005	-0.0012	0.0027	-0.0057	-0.0069	-0.0033
	(-1.4)	(-3.0)	(4.0)	(-9.6)	(-9.8)	(-1.0)
HMOPOP#	0.0009	0.0006	0.0014	0.0011	0.0004	0.0018
	(2.5)	(1.1)	(1.6)	(4.5)	(1.2)	(2.8)
NBEDPOP	-0.0697	-6.2439	-0.0830			
	(-0.1)	(-2.8)	(-0.1)			
NBEDPOP#	-4.1012	-4.9835	-3.0948			
	(-3.6)	(-2.1)	(-2.5)			
R^2	0.67	0.70	0.72	0.89	0.90	0.89
N	7896	3768	4128	7896	3768	4128

TABLE 6.7

QUARTERLY HOSPITAL DAYS PER ENROLLEE
Waivered and Nonwaivered States

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.9550 (76.5)	0.9379 (47.2)	1.0802 (63.1)			
URBAN	-0.0225 (-5.6)					
SPRING	-0.0540 (-16.0)	-0.0480 (-10.7)	-0.0683 (-13.8)	-0.0540 (-26.7)	-0.0480 (-17.8)	-0.0683 (-22.0)
SUMMER	-0.0890 (-26.4)	-0.0801 (-17.8)	-0.1100 (-22.2)	-0.0890 (-44.1)	-0.0801 (-29.7)	-0.1100 (-35.5)
AUTUMN	-0.0949 (-26.4)	-0.0825 (-17.3)	-0.1234 (-23.3)	-0.0949 (-44.0)	-0.0828 (-28.7)	-0.1234 (-37.3)
REGION2	-0.0385 (-7.4)	-0.0801 (-11.1)	0.0366 (4.8)			
REGION3	-0.0336 (-6.5)	-0.0596 (-7.7)	-0.0100 (-1.6)			
REGION4	-0.1556 (-27.2)	-0.1808 (-18.5)	-0.1380 (-21.5)			
REGION5	-0.1988 (-40.2)	-0.1940 (-29.7)	-0.2253 (-27.4)			
AUT86DUM	-0.0973 (-13.5)	-0.1139 (-11.8)	-0.0578 (-5.4)	-0.0973 (-22.5)	-0.1139 (-19.7)	-0.0578 (-8.7)
DYR82	-0.1150 (-8.1)	0.1210 (6.5)	0.0512 (1.7)	0.0883 (13.5)	0.0966 (11.0)	0.0277 (1.6)
DYR83	-0.0073 (-0.7)	0.0061 (0.5)	0.0134 (0.5)	0.0075 (1.2)	0.0095 (1.2)	0.0052 (0.3)
DYR84	-0.1539 (-10.9)	-0.1187 (-5.8)	-0.1771 (-5.6)	-0.1605 (-18.8)	-0.1060 (-8.3)	-0.1817 (-9.2)
DYR85	-0.0523 (-3.3)	-0.0404 (-1.9)	-0.0693 (-2.2)	-0.0384 (-4.1)	-0.0226 (-1.7)	-0.0661 (-3.3)
DYR86	-0.0709 (-4.6)	-0.0435 (-2.5)	-0.2535 (-4.1)	-0.0202 (-2.1)	-0.0195 (-1.8)	-0.0089 (-0.2)
BENPOP	-0.0067 (-13.2)	-0.0076 (-10.9)	-0.0091 (-11.2)	-0.0264 (-7.1)	-0.0410 (-7.7)	-0.0074 (-1.4)
HBEDPOP	45.6738 (29.0)	44.7089 (19.6)	48.7301 (23.2)	47.5905 (6.9)	57.867 (5.6)	30.9538 (3.6)
HBEDPOP#	-17.8863 (-7.6)	-19.4281 (-5.6)	-16.1164 (-5.1)	-19.2124 (-13.7)	-20.322 (-9.6)	0.0016 (2.5)
PHYSPOP	-39.9896 (-10.5)	-17.8528 (-3.3)	-163.549 (-17.7)	21.4549 (1.4)	16.707 (0.4)	3.4781 (0.2)
PHYSPOP#	33.9074 (8.2)	19.0310 (2.8)	62.826 (5.3)	39.2664 (15.4)	16.6317 (3.9)	69.8571 (9.2)

TABLE 6.7 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	-0.0007 (-2.2)	-0.0011 (-2.8)	0.0027 (4.0)	-0.0049 (-8.5)	-0.0061 (-8.7)	0.0015 (0.5)
HMOPOP#	0.0010 (2.5)	0.0006 (1.1)	0.0011 (1.2)	0.0012 (4.7)	0.0005 (1.5)	0.0016 (2.5)
NBEDPOP	-0.4473 (-0.4)	-6.0898 (-2.9)	-0.0009 (0.0)			
NBEDPOP#	-3.8496 (-3.3)	-4.2409 (-1.9)	-2.9875 (-2.3)			
WAIVER	0.1235 (14.4)	0.1183 (11.2)	0.2322 (11.1)			
MANY86	-0.0526 (-3.3)	-0.0823 (-4.4)	0.1060 (1.7)	-0.1228 (-11.9)	-0.1134 (-9.4)	-0.1678 (-3.9)
(1-WAIVER)DYR82	-0.0381 (-3.3)	-0.0453 (-3.3)	0.0285 (1.0)	-0.0383 (-5.6)	-0.0431 (-5.1)	0.0189 (1.1)
(1-WAIVER)DYR83	-0.0364 (-3.2)	-0.0330 (-2.4)	-0.0465 (-1.6)	-0.0342 (-5.0)	-0.0297 (-3.6)	-0.0406 (-2.3)
(1-WAIVER)DYR84	-0.0548 (-4.7)	-0.0617 (-4.4)	-0.0555 (-1.9)	-0.0504 (-7.2)	-0.0589 (-6.8)	-0.0579 (-3.2)
(1-WAIVER)DYR85	0.0417 (3.7)	0.0473 (3.5)	0.0396 (1.4)	0.0422 (6.3)	0.0505 (6.2)	0.0391 (2.2)
(1-WAIVER)DYR86	-0.0526 (-3.3)	0.0333 (1.8)	0.2403 (3.9)	0.0123 (1.3)	0.0131 (1.1)	-0.0045 (-0.1)
R^2	0.73	0.75	0.72	0.91	0.91	0.90
N	8376	4032	4344	8376	4032	4344

TABLE 6.8

QUARTERLY MEDICARE REHOSPITALIZATIONS PER HOSPITAL ADMISSION
Nonwaivered States Only

	--------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.1444 (86.2)	0.1318 (53.3)	0.1410 (51.7)			
URBAN	-0.0133 (-24.4)					
SPRING	0.0024 (5.0)	0.0025 (4.1)	0.0023 (2.9)	0.0024 (6.1)	0.0025 (4.9)	0.0023 (3.5)
SUMMER	0.0037 (7.8)	0.0041 (6.8)	0.0031 (3.9)	0.0037 (9.4)	0.0041 (8.1)	0.0031 (4.7)
AUTUMN	0.0026 (5.1)	0.0029 (4.6)	0.0020 (2.4)	0.0026 (6.2)	0.0029 (5.5)	0.0020 (2.8)
REGION2	0.0145 (15.9)	0.0110 (7.9)	0.0159 (13.3)			
REGION3	0.0052 (7.7)	0.0038 (4.1)	0.0060 (6.0)			
REGION4	0.0018 (2.4)	0.0002 (0.1)	0.0021 (2.1)			
REGIONS5	0.0102 (15.5)	0.0113 (14.2)	0.0058 (4.4)			
AUT86DUM	-0.0417 (-40.5)	-0.0421 (-32.8)	-0.0409 (-23.8	-0.0417 (-48.7)	-0.0421 (-39.3)	-0.0409 (-28.5)
DYR82	0.0113 (9.5)	0.0108 (5.9)	0.0096 (4.9)	0.0085 (16.0)	0.0094 (3.5)	0.0096 (11.3)
DYR83	0.0036 (6.0)	0.0045 (6.0)	0.0016 (1.6)	0.0028 (5.4)	0.0061 (2.3)	0.0017 (2.1)
DYR84	-0.0060 (-5.5)	0.0001 (0.1)	-0.0023 (-1.2)	-0.0050 (-5.5)	-0.0009 (-0.3)	-0.0033 (-2.0)
DYR85	0.0003 (0.2)	-0.0011 (-0.5)	0.0062 (2.5)	0.0008 (0.6)	0.0051 (1.6)	0.0075 (3.5)
DYR86	-0.0028 (-4.5)	-0.0014 (-1.8)	-0.0058 (-5.5)	-0.0028 (-5.2)	-0.0067 (-2.6)	-0.0051 (-5.6)
BENPOP	-0.0001 (-1.4)	-0.0003 (-3.4)	0.0003 (2.0)	-0.0001 (-0.20)	0.0018 (1.9)	-0.0028 (-2.5)
HBEDPOP	2.9398 (13.8)	2.5661 (9.2)	3.8271 (11.3)	4.9642 (3.8)	5.5852 (3.1)	3.4237 (1.7)
HBEDPOP#	0.1701 (0.5)	0.7266 (1.7)	-1.4646 (-2.9)	-0.0406 (-0.2)	0.6158 (1.7)	-1.5980 (-3.8)
PHYSPOP	-8.4434 (-15.9)	-5.8311 (-8.5)	-8.7857 (-5.9)	7.2389 (2.6)	10.9075 (1.6)	4.9305 (1.6)
PHYSPOP#	4.3218 (7.5)	1.0026 (1.1)	0.9188 (0.5)	3.5040 (7.1)	0.5427 (0.7)	2.4766 (1.5)

TABLE 6.8 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0003	0.0003	0.0002	0.0008	0.0005	-0.0002
	(7.3)	(5.7)	(1.9)	(7.1)	(4.1)	(-0.2)
HMOPOP#	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
	(-3.1)	(-3.4)	(-1.3)	(-4.4)	(-3.7)	(-1.5)
NBEDPOP	-0.7967	-1.0631	-1.1714			
	(-5.5)	(-4.0)	(-6.0)			
NBEDPOP#	-0.2530	-0.2584	0.0347			
	(-1.6)	(-0.9)	(0.2)			
R^2	0.42	0.43	0.30	0.62	0.62	0.53
N	7896	3768	4128	7896	3768	4128

TABLE 6.9

QUARTERLY MEDICARE REHOSPITALIZATIONS
PER HOSPITAL ADMISSION
Waivered and Nonwaivered States

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.1450 (86.8)	0.1298 (52.5)	0.1428 (53.4)			
URBAN	-0.0137 (-25.6)					
SPRING	0.0023 (5.1)	0.0024 (4.4)	0.0021 (2.7)	0.0023 (6.3)	0.0024 (5.4)	0.0021 (3.2)
SUMMER	0.0038 (8.4)	0.0041 (7.3)	0.0030 (3.9)	0.0038 (10.3)	0.0041 (9.1)	0.0030 (4.7)
AUTUMN	0.0026 (5.5)	0.0029 (4.8)	0.0020 (2.4)	0.0026 (6.7)	0.0029 (6.0)	0.0020 (2.9)
REGION2	0.0081 (11.7)	0.0046 (5.1)	0.0158 (13.4)			
REGION3	0.0042 (6.1)	0.0033 (3.4)	0.0058 (5.8)			
REGION4	0.0009 (1.1)	-0.0003 (-0.2)	0.0017 (1.7)			
REGION5	0.0100 (15.1)	0.0114 (14.1)	0.0063 (4.9)			
AUT86DUM	-0.0426 (-43.9)	-0.0431 (-36.0)	-0.0411 (-24.7)	-0.0426 (-54.0)	-0.0431 (-44.8)	-0.0184 (-2.0)
DYR82	0.0127 (7.5)	0.0132 (5.7)	0.0070 (1.5)	0.0088 (7.4)	0.0089 (6.1)	0.0073 (2.0)
DYR83	0.0071 (5.1)	0.0069 (4.5)	0.0078 (1.8)	0.0057 (5.0)	0.0058 (4.5)	0.0073 (2.0)
DYR84	-0.0104 (-5.5)	-0.0035 (-1.4)	-0.0064 (-1.3)	-0.0099 (-6.4)	-0.0044 (-2.1)	-0.0070 (-1.7)
DYR85	0.0029 (1.4)	0.0011 (0.4)	0.0110 (2.3)	0.0038 (2.3)	0.0025 (1.1)	0.0120 (2.9)
DYR86	0.0063 (3.1)	0.0082 (3.7)	0.0054 (0.6)	0.0087 (5.1)	0.0077 (4.2)	0.0183 (2.1)
BENPOP	-0.0002 (-3.5)	-0.0004 (-4.4)	0.0001 (0.8)	-0.000001 (-0.01)	0.0013 (1.4)	-0.0024 (-2.2)
HBEDPOP	2.8437 (13.5)	2.3752 (8.4)	4.0827 (12.4)	4.1563 (3.3)	5.2204 (3.0)	2.4156 (1.3)
HBEDPOP#	0.1591 (0.5)	0.6828 (1.6)	-1.4947 (-3.0)	-0.0891 (-0.3)	0.3016 (0.9)	-1.5797 (-3.8)
PHYSPOP	-7.8532 (-15.4)	-5.5516 (-8.3)	-9.6153 (-6.7)	7.4087 (2.7)	7.7318 (1.2)	4.8704 (1.6)
PHYSPOP#	4.2973 (7.7)	1.4405 (1.7)	1.0059 (0.5)	3.8469 (8.3)	1.6808 (2.4)	2.1952 (1.4)

TABLE 6.9 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0003	0.0002	0.0002	0.0007	0.0004	-0.0002
	(6.5)	(5.0)	(1.7)	(6.7)	(3.9)	(-0.3)
HMOPOP#	-0.0001	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
	(-2.7)	(-3.1)	(-1.3)	(-4.5)	(-3.9)	(-1.2)
NBEDPOP	-0.4981	-0.3834	-1.1427			
	(-3.4)	(-1.5)	(-5.9)			
NBEDPOP#	-0.3070	-0.3812	0.0161			
	(-2.0)	(-1.4)	(0.1)			
WAIVER	-0.0061	-0.0059	-0.0052			
	(-5.3)	(-4.5)	(-1.6)			
MANY86	-0.0026	-0.0048	-0.0042	-0.0061	-0.0044	-0.0184
	(-1.2)	(-2.0)	(-0.4)	(-3.2)	(-2.2)	(-2.1)
(1-WAIVER)DYR82	-0.0010	-0.0017	0.0028	-0.0003	-0.0008	0.0022
	(-0.7)	(-1.0)	(0.6)	(-0.2)	(-0.5)	(0.6)
(1-WAIVER)DYR83	-0.0035	-0.0024	-0.0061	-0.0030	-0.0022	-0.0057
	(-2.3)	(-1.4)	(-1.4)	(-2.4)	(-1.6)	(-1.5)
(1-WAIVER)DYR84	0.0046	0.0028	0.0040	0.0044	0.0031	0.0039
	(2.9)	(1.6)	(0.9)	(3.4)	(2.2)	(1.0)
(1-WAIVER)DYR85	-0.0027	-0.0021	-0.0046	-0.0027	-0.0021	-0.0047
	(-1.8)	(-1.3)	(-1.1)	(-2.2)	(-1.5)	(-1.3)
(1-WAIVER)DYR86	-0.0089	-0.0093	-0.0110	-0.0113	-0.0090	-0.0234
	(-4.2)	(-4.0)	(-1.1)	(-6.4)	(-4.8)	(-2.7)
R^2	0.45	0.46	0.30	0.65	0.66	0.53
N	8376	4032	4344	8376	4032	4344

VII. POST-HOSPITAL CARE: HOME HEALTH AND SKILLED NURSING FACILITIES

As hospital admissions and lengths of stay of Medicare enrollees declined during the 1980's, SNF and HHA utilization rose. The increase was far from uniform, however, as Figures 11 through 20 of Chapter 3 showed. Though SNF admissions overall rose by just two per 10,000 enrollees, rural admissions per enrollee increased by approximately 50 percent, and urban admissions declined by 10 percent. Home health visits per enrollee rose in both urban and rural areas, though once again the increase in rural areas was greater. This chapter examines the determinants of HHA and SNF care and assesses the extent of substitution of HHA and SNF care in the 30-day period after a hospital discharge for inpatient days of care.

Home Health Care

PPS appears to have increased the use of home health visits by Medicare enrollees. Estimates of PPS effects on HHA care are shown in Table 7.1. Nearly every estimate of the effect of PPS on alternative measures of HHA care is positive and statistically significant; none of the three negative estimates attained statistical significance. Pre-post and double-difference estimates are roughly the same size. On the basis of these estimates, PPS may be inferred to have increased covered HHA visits per enrollee by 0.03 to 0.06 visits per quarter, HHA visits in the 30-day period following hospital discharge by 0.14 to 0.29, and the fraction of Medicare hospital stays followed by HHA care by 0.01 to 0.02. These results suggest but do not conclusively show that the PPS-induced reduction in hospital utilization, particularly length of stay, documented in Chapter 6 stimulated increased use of home care in the mid-1980s.

The estimates in Table 7.1 were derived from the regression results of Tables 7.5 through 7.10, which present OLS and fixed-effect estimates of the determinants of HHA visits per enrollee, HHA visits in the 30-day period following hospital discharge, and the fraction of hospital stays followed by HHA care within 30 days of discharge. Adding the fixed-effect coefficients DYR82 through DYR84 in Tables 7.5, 7.7, and 7.9 produces an estimate of the change in the three measures of HHA care between 1981 and 1984, other things held constant. Expressed as a fraction of this sum, the PPS effects cited above can be seen to account for between 21 and 42 percent of the increase in HHA visits per enrollee, between 27 and 55 percent of the increase in HHA visits in the 30-day post-discharge period and between 19 and 39 percent of the increase in the fraction of hospital stays followed by HHA care between 1981 and 1984.

Market variables should affect levels of HHA care both independently and also

TABLE 7.1

REGRESSION ESTIMATES OF PPS EFFECTS ON HHA CARE

Pre-Post	Covered Visits Per Enrollee	Covered Visits in 30-Day Postdischarge Period Per Hospital Admission	Fraction of Hospital Admissions Followed by HHA Care
Estimator 1	0.0557**	0.1706**	0.0203**
Estimator 2	0.0464**	0.1683**	0.0173**
Estimator 3	0.0060	-0.0157	0.0034**
Estimator 4	-0.0033	-0.0179	0.0004
Double Difference			
Estimator 5	0.0433**	0.1663**	0.0104**
Estimator 6	0.0316**	0.1379**	0.0091**
Estimator 7	0.0620**	0.2924**	0.0175**
Estimator 8	0.0504**	0.2641**	0.0162**

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*Estimate significant at 0.10 level (two-sided test).
**Estimate significant at 0.05 level (two-sided test).

indirectly, via their effects on hospital utilization. If this indirect effect is dominant, and if HHA care substitutes to some degree for days of stay in hospital, then market variables would tend to have opposite signs in regressions for HHA care and say, hospital length of stay. In urban areas, this prediction is generally borne out. Physicians per capita and HMO enrollment per 100 population are both associated with lower hospital lengths of stay, as indicated by the fixed-effect estimates of Tables 6.4 and 6.5. Both are, in turn, associated with increased usage of HHA care after hospital discharge as the fixed-effect estimates of Tables 7.7 through 7.10 show. In addition, hospital beds per capita, which has no effect on length of stay in urban areas, also seems not to affect use of HHA care following discharge.

Because some market variables may have independent effects on utilization, this sort of evidence for substitution is not likely to be uniform. Increases in enrollees per capita are associated with both reduced hospital lengths of stay and reduced use of post-discharge HHA care. In rural areas, increases in hospital beds per capita seem to increase both lengths of stay and post-hospital HHA use. Rural HMO membership is estimated to depress both the duration of hospital stays and HHA use. Regional differences in hospital utilization are also replicated in HHA use. The west and northwest (REGION5) have the lowest levels of both hospital and HHA use. Areas in the south and southeast (REGION2), which have some of the highest rates of use of hospital care, also exhibit the highest use of HHA care.

Utilization of Skilled Nursing Facilities

The effects of PPS on SNF care given to Medicare enrollees are difficult to characterize. There is certainly no evidence that PPS has resulted in diminished SNF care in rural areas; effects on care in urban areas, however, are uncertain and subject to conflicting interpretation. Table 7.2, which presents estimates of the PPS measures derived in Chapter 4, conceals this urban-rural discrepancy. The table suggests that use of SNF care increased in 1983 and 1984 more rapidly than in 1982. This increase, however, was not significantly greater in nonwaivered states than in waivered states.

The urban-rural differences may be seen in more detail by examining the variable DYR84 in the fixed-effect models estimated for nonwaivered states only and the variable (1-WAIVER)DYR84 in the fixed-effect models estimated for waivered and nonwaivered states together. All three measures of SNF care increased markedly in 1984 in rural areas. (See DYR84 in Tables 7.11, 7.13, and 7.15). Declines in succeeding years were in no case sufficient to offset even half of the increase experienced in 1984. However, the rural increases were not significantly greater in nonwaivered than in

TABLE 7.2

REGRESSION ESTIMATES OF PPS EFFECTS ON SNF CARE

Pre-Post	Covered Admissions Per Enrollee	Covered Visits in 30-Day Postdischarge Period Per Hospital Admission	Fraction of Hospital Admissions Followed by SNF Care
Estimator 1	0.0012**	0.1640**	0.0135**
Estimator 2	0.0007**	0.0949**	0.0071**
Estimator 3	0.0010**	0.1190**	0.0116**
Estimator 4	0.0005**	0.0504**	0.0058**
Double Difference			
Estimator 5	0.0001	0.0036	0.0005
Estimator 6	0.0001	0.0084	0.0008
Estimator 7	0.0001	-0.0040	0.0008
Estimator 8	0.0001	-0.0009	0.0012

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*Estimate significant at 0.10 level (two-sided test).
**Estimate significant at 0.05 level (two-sided test).

waivered areas in 1984 (though they were in 1985--see [1-WAIVER]DYR84 in Tables 7.12, 7.14, and 7.16). The magnitude of the increase in rural SNF care in 1984 relative to surrounding years clearly suggests that PPS played an important role in raising the level of rural SNF care. The absence of an increase in SNF care in rural parts of nonwaivered states relative to rural parts of waivered states may be a result of the paucity of rural areas in waivered states.

Urban areas also experienced an increase in SNF care in 1984, as may again be seen by examination of DYR84 in the models estimated for nonwaivered states. In every instance, however, the subsequent decline in SNF care in 1985 was more than sufficient to offset the increase, leaving overall PPS effects subject to question. The double-difference estimates given by (1-WAIVER)DYR84 are all positive and significant for urban areas. This increase in SNF care relative to that in waivered states is not reversed in later years. The interpretation of PPS effects on SNF care in urban areas, then, hinges on the meaning given to differences between waivered and nonwaivered states, as opposed to changes in levels of SNF care in nonwaivered states after 1984. The pre-post estimates for urban areas suggest that PPS has had no lasting effect on levels of SNF care. That SNF care nevertheless increased in PPS states relative to waivered states could indicate that SNF care would have declined even more had PPS not been implemented. In this case, PPS should definitely be regarded as having increased SNF use in urban areas.

Increases in the market variables studied here generally appear to reduce use of SNF care in both urban and rural areas. Hospital beds and physicians per capita are both associated with reduced SNF use. Increased HMO membership per capita also tends to lower Medicare SNF use in urban localities. Finally, greater concentration of enrollees in the population (BENPOP) tends to reduce SNF use as it does for most other measures of Part A care. Note also that REGION4 and REGION5, which exhibited the lowest levels of hospital and HHA care, show the highest rates of SNF utilization.

Correlation Analyses

A more direct approach to measuring substitution of hospital for post-hospital care is simply to compare changes in length of stay and prevailing levels of SNF and HHA care in an area. Tables 7.3 and 7.4 show correlations of levels of post-hospital care (SNF and HHA) and the one year change in length of stay and readmission rates for 1982 and 1985. Zero-order correlations were computed at this stage of the research rather than regression equations using lagged utilization. The correlations impose little structure and present fewer statistical traps. (In future work, the fixed-effect model will be

TABLE 7.3

LEVELS OF POST-HOSPITAL CARE AND SUBSEQUENT CHANGES IN HOSPITAL LENGTH OF STAY AND READMISSION RATES

Correlation Coefficients - Urban

1981 Levels	Change in Hospital Length of Stay (1981-1982)	Change in Hospital Readmission Rates (1981-1982)
SNF Days per Hospital Admit	-0.08*	-0.02
Fraction of Hosp Admits w/SNF	0.04	-0.05
HHA Visits per Hosp Admit	-0.01	0.03
Fraction of Hosp Admits w/HHA	-0.08**	0.02

1984 Levels	Change in Hospital Length of Stay (1981-1982)	Change in Hospital Readmission Rates (1981-1982)
SNF Days per Hospital Admit	-0.19**	0.03
Fraction of Hosp Admits w/SNF	0.11**	-0.08**
HHA Visits per Hosp Admit	-0.07*	-0.03
Fraction of Hosp Admits w/HHA	-0.13**	-0.02

Note: SNF days and HHA visits are considered as "post-hospital" care if they occur within 30 days of discharge.

TABLE 7.4

LEVELS OF POST-HOSPITAL CARE AND SUBSEQUENT CHANGES IN HOSPITAL LENGTH OF STAY AND READMISSION RATES

Correlation Coefficients - Rural

1981 Levels	Change in Hospital Length of Stay (1981-1982)	Change in Hospital Readmission Rates (1981-1982)
SNF Days per Hospital Admit	0.00	-0.00
Fraction of Hosp Admits w/SNF	-0.09**	-0.06*
HHA Visits per Hosp Admit	-0.09**	-0.01
Fraction of Hosp Admits w/HHA	-0.12**	-0.05

1984 Levels	Change in Hospital Length of Stay (1981-1982)	Change in Hospital Readmission Rates (1981-1982)
SNF Days per Hospital Admit	-0.09**	0.07*
Fraction of Hosp Admits w/SNF	-0.01	-0.14**
HHA Visits per Hosp Admit	0.02	-0.04
Fraction of Hosp Admits w/HHA	0.03	-0.04

Note: SNF days and HHA visits are considered as "post-hospital" care if they occur within 30 days of discharge.

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED MORTALITY

compared to a model with lagged utilization to test for the randomness of area effects and provide more interpretable measures of substitution.)

The tables show weak but generally significant negative correlations between levels of post-hospital care in an area and subsequent one year changes in hospital length of stay and rehospitalization rates. Of the ten statistically significant estimated correlations between levels of post-hospital care and changes in hospital length of stay, only one is positive. Of four significant correlations between levels of post-hospital care and rehospitalization rates, one is positive. For reasons yet to be investigated, the substitution appears stronger in rural areas in 1981-1982 and stronger in urban areas in 1984-1985. There is no obvious indication from the coefficients of any superiority of SNF or HHA in facilitating reductions in length of stay. However, there was no significant correlation between levels of home health care and changes in rehospitalization rates.

TABLE 7.5

QUARTERLY HHA VISITS PER ENROLLEE
Nonwaivered States Only

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0861 (5.7)	0.0641 (2.8)	0.1613 (6.9)			
URBAN	-0.0052 (-1.1)					
SPRING	-0.0048 (-1.1)	-0.0085 (-1.5)	0.0025 (0.4)	-0.0048 (-2.1)	-0.0085 (-2.7)	0.0025 (0.8)
SUMMER	-0.0073 (-1.7)	-0.0121 (-2.2)	0.0021 (0.3)	-0.0073 (-3.2)	-0.0121 (-3.9)	0.0021 (0.6)
AUTUMN	0.0054 (1.2)	-0.0001 (-0.0)	0.0161 (2.2)	0.0054 (2.2)	-0.0001 (-0.0)	0.0161 (4.6)
REGION2	0.1579 (19.2)	0.1220 (9.5)	0.1983 (19.5)			
REGION3	0.0328 (5.4)	0.0310 (3.6)	0.0439 (5.1)			
REGION4	-0.0545 (-8.0)	-0.0412 (-3.8)	-0.0958 (-11.1)			
REGION5	-0.1207 (-20.4)	-0.1288 (-17.6)	-0.1046 (-9.5)			
AUT86DUM	-0.0268 (-2.9)	-0.0282 (-2.4)	-0.0240 (-1.6)	-0.0268 (-5.5)	-0.0282 (-4.2)	-0.0240 (-3.4)
DYR82	0.1025 (9.5)	0.1004 (5.9)	0.1513 (9.0)	0.0498 (16.4)	0.0377 (7.7)	0.0652 (15.4)
DYR83	0.0330 (6.1)	0.0400 (5.8)	0.0185 (2.2)	0.0372 (12.8)	0.0414 (9.3)	0.0241 (5.8)
DYR84	0.0606 (6.2)	0.0583 (3.4)	0.1188 (7.2)	0.0557 (10.8)	0.0609 (6.2)	0.1055 (12.9)
DYR85	0.0030 (0.2)	0.0013 (0.1)	0.0125 (0.6)	0.0138 (1.7)	0.0012 (0.1)	0.0532 (5.0)
DYR86	-0.0179 (-3.1)	-0.0256 (-3.5)	-0.0002 (-0.02)	-0.0150 (-4.9)	-0.0250 (-6.1)	0.0062 (1.4)
BENPOP	0.0122 (19.7)	0.0167 (21.4)	-0.0035 (-3.1)	-0.0049 (-1.2)	0.0133 (2.3)	-0.0344 (-6.2)
HBEDPOP	-2.7893 (-1.5)	-18.3588 (-7.1)	28.7625 (10.0)	33.6788 (4.5)	-6.9525 (-0.6)	86.3577 (8.9)
HBEDPOP#	2.6380 (0.9)	3.6760 (0.9)	-0.5476 (-0.1)	0.9869 (0.7)	3.5168 (1.6)	-7.6031 (-3.6)
PHYSPOP	36.5638 (7.6)	62.6121 (9.9)	-12.5443 (-1.0)	21.9339 (1.4)	77.3742 (1.9)	0.1687 (0.0)
PHYSPOP#	-6.2904 (-1.2)	-4.4202 (-0.5)	-71.7455 (-4.5)	0.3033 (0.1)	-3.9542 (-0.9)	-45.5167 (-5.6)

TABLE 7.5 (continued

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0015 (4.1)	0.0006 (1.4)	0.0041 (4.4)	0.0004 (0.7)	-0.0009 (-1.1)	-0.0164 (-4.5)
HMOPOP#	-0.0024 (-5.3)	-0.0023 (-3.9)	-0.0022 (-1.8)	-0.0022 (-8.5)	-0.0018 (-5.2)	-0.0008 (-1.1)
NBEDPOP	-11.1544 (-8.5)	-9.7359 (-3.9)	-7.9241 (-4.8)			
NBEDPOP#	-8.3189 (-6.0)	-10.7589 (-4.0)	-10.4632 (-6.1)			
R^2	0.32	0.39	0.31	0.82	0.84	0.81
N	7896	3768	4128	7896	4128	3768

TABLE 7.6

QUARTERLY HHA VISITS PER ENROLLEE
Waivered and Nonwaivered States

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0747 (4.8)	0.0323 (1.4)	0.1454 (6.4)			
URBAN	0.0044 (0.9)					
SPRING	-0.0042 (-1.0)	-0.0069 (-1.3)	0.0023 (0.4)	-0.0042 (-2.0)	-0.0069 (2.4)	-0.0023 (0.7)
SUMMER	-0.0088 (-2.1)	-.0132 (-2.4)	0.0016 (0.2)	-0.0088 (-4.1)	-0.0132 (-4.5)	0.0016 (0.5)
AUTUMN	0.0030 (0.7)	-0.0017 (-0.3)	0.0140 (2.0)	0.0030 (1.3)	-0.0017 (-0.5)	0.0140 (4.1)
REGION2	0.0944 (14.6)	0.0621 (7.2)	0.1948 (19.5)			
REGION3	0.0234 (3.7)	0.0310 (3.3)	0.0450 (5.3)			
REGION4	-0.0639 (-9.0)	-0.0394 (-3.4)	-0.0923 (-10.9)			
REGION5	-0.1174 (-19.2)	-0.1145 (-14.6)	-0.1091 (-10.0)			
AUT86DUM	-0.0290 (-3.2)	-0.0311 (-2.7)	-0.0239 (-1.7)	-0.0290 (-6.3)	-0.0311 (-4.9)	-0.0239 (-3.5)
DYR82	0.1113 (7.1)	0.1142 (5.1)	0.1236 (3.2)	0.0695 (10.0)	0.0633 (6.7)	0.0694 (3.8)
DYR83	0.0142 (1.1)	0.0168 (1.2)	-0.0192 (-0.5)	0.0190 (2.8)	0.0186 (2.2)	-0.0041 (-0.2)
DYR84	0.0250 (1.4)	0.0124 (0.5)	0.1092 (2.6)	0.0077 (0.9)	0.0127 (0.9)	0.0900 (4.4)
DYR85	-0.0196 (-1.0)	-0.0299 (-1.2)	0.0211 (0.5)	-0.0046 (-0.5)	-0.0213 (-1.5)	0.0694 (3.4)
DYR86	-0.0813 (-4.3)	-0.0520 (-2.4)	-0.1288 (-1.6)	-0.0255 (-2.5)	-0.0276 (-2.3)	-0.0143 (-0.3)
BENPOP	0.0116 (18.3)	0.0170 (20.2)	-0.0018 (-1.6)	-0.0132 (-3.4)	0.0006 (0.1)	-0.0353 (-6.5)
HBEDPOP	-1.5387 (-0.8)	-14.5322 (-5.3)	26.4696 (9.5)	40.0631 (5.5)	8.2000 (0.7)	81.9904 (9.2)
HBEDPOP#	2.4167 (0.8)	3.8603 (0.9)	-0.7054 (-0.2)	0.7811 (0.5)	3.3045 (1.4)	-7.9159 (-3.8)
PHYSPOP	31.0796 (6.6)	48.2663 (7.5)	-8.4988 (-0.7)	24.1015 (1.5)	69.0323 (1.7)	0.9144 (0.1)
PHYSPOP#	-3.9511 (-0.8)	1.4491 (0.2)	-71.6182 (-4.6)	4.9574 (1.8)	2.7298 (0.6)	-44.6996 (-5.7)

TABLE 7.6 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0015 (3.8)	0.0006 (1.3)	0.0045 (4.9)	-0.0010 (-1.6)	-0.0019 (-2.6)	-0.0174 (-5.7)
HMOPOP#	-0.0023 (-4.8)	-0.0020 (-3.3)	-0.0023 (-1.9)	-0.0023 (-8.7)	-0.0020 (-5.4)	-0.0008 (-1.2)
NBEDPOP	-8.4339 (-6.3)	-3.8303 (-1.5)	-8.0559 (-4.9)			
NBEDPOP#	-7.5429 (-5.3)	-8.2705 (-3.0)	-10.3305 (-6.1)			
WAIVER	-0.0012 (-0.1)	-0.0152 (-1.2)	0.0296 (1.1)			
MANY86	0.0830 (4.1)	0.0419 (1.8)	0.1200 (1.5)	0.0058 (0.5)	0.0078 (0.6)	-0.0054 (-0.1)
(1-WAIVER)DYR82	-0.0136 (-1.0)	-0.0272 (-1.6)	0.0262 (0.7)	-0.0188 (-2.6)	-0.0232 (-2.5)	-0.0042 (-0.2)
(1-WAIVER)DYR83	0.0191 (1.4)	0.0240 (1.5)	0.0374 (1.0)	0.0200 (2.8)	0.0261 (2.9)	0.0282 (1.5)
(1-WAIVER)DYR84	0.0321 (2.2)	0.0349 (2.1)	0.0091 (0.2)	0.0433 (5.8)	0.0390 (4.2)	0.0148 (0.8)
(1-WAIVER)DYR85	0.0227 (1.6)	0.0275 (1.7)	-0.0081 (-0.2)	0.0235 (3.3)	0.0292 (3.3)	-0.0142 (-0.8)
(1-WAIVER)DYR86	0.0641 (3.3)	0.0272 (1.2)	0.1281 (1.6)	0.0122 (1.2)	0.0048 (0.4)	0.0207 (0.5)
R^2	0.28	0.32	0.30	0.82	0.81	0.84
N	8376	4032	4344	8376	4032	4344

TABLE 7.7

QUARTERLY HHA VISITS IN 30-DAY POST DISCHARGE PERIOD PER HOSPITAL ADMISSION
Nonwaivered States Only

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	-0.3857 (-7.8)	-0.2514 (-3.1)				
URBAN	0.1788 (11.1)					
SPRING	-0.0169 (-1.2)	-0.0250 (-1.3)	-0.0009 (-0.1)	-0.0169 (-2.2)	-0.0250 (-2.2)	-0.0009 (-0.1)
SUMMER	0.0751 (5.3)	0.0709 (3.6)	0.0835 (4.9)	0.0751 (9.8)	0.0709 (6.3)	0.0835 (8.7)
AUTUMN	0.1100 (7.2)	0.1079 (5.1)	0.1144 (6.3)	0.1101 (13.5)	0.1079 (8.9)	0.1144 (11.2)
REGION2	0.3007 (11.1)	0.4232 (9.2)	0.3284 (12.8)			
REGION3	0.2866 (14.3)	0.3178 (10.3)	0.2434 (11.3)			
REGION4	0.0305 (1.4)	0.0235 (0.6)	-0.1695 (-7.8)			
REGION5	-0.3929 (-20.3)	-0.5337 (-20.3)	-0.1565 (-5.6)			
AUT86DUM	-0.1688 (-5.5)	-0.2018 (-4.7)	-0.1025 (-2.8)	-0.1688 (-10.3)	-0.2018 (-8.3)	-0.1025 (-5.0)
DYR82	0.3489 (9.8)	0.4274 (7.0)	0.3550 (8.4)	0.1863 (18.2)	0.1585 (8.9)	0.1869 (15.3)
DYR83	0.1335 (7.6)	0.1508 (6.1)	0.0905 (4.3)	0.1662 (16.9)	0.1768 (10.9)	0.1144 (9.6)
DYR84	0.1843 (5.7)	0.2552 (4.2)	0.3156 (7.6)	0.1706 (9.8)	0.2873 (8.0)	0.2958 (12.6)
DYR85	0.2384 (4.7)	0.2896 (3.6)	0.2697 (5.1)	0.3152 (11.7)	0.3357 (7.2)	0.3824 (12.5)
DYR86	0.0517 (2.8)	0.0415 (1.6)	0.0844 (3.7)	0.0901 (8.8)	0.0779 (5.2)	0.1129 (8.6)
BENPOP	0.1025 (50.6)	0.1286 (45.9)	0.0121 (4.3)	-0.1366 (-10.2)	-0.1504 (-7.2)	-0.1266 (-7.9)
HBEDPOP	-146.9 (-23.3)	-231.2 (-24.9)	-2.8561 (-0.4)	12.4036 (0.5)	-95.6840 (-2.4)	142.3272 (5.1)
HBEDPOP#	-7.5874 (-0.8)	-11.9 (-0.8)	-19.1709 (-1.8)	-12.1527 (-2.5)	-7.6283 (-1.0)	-36.4778 (-6.0)
PHYSPOP	372.9190 (23.7)	476.4 (21.1)	323.212 (10.2)	128.0224 (2.4)	585.3294 (3.9)	-47.2657 (-1.1)
PHYSPOP#	34.2858 (2.0)	-4.4273 (-0.2)	-100.957 (-2.5)	57.8986 (6.2)	-7.2155 (-0.4)	-43.8097 (-1.8)

TABLE 7.7 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0141 (11.3)	0.0126 (7.8)	0.0234 (10.1)	0.0221 (10.4)	0.0160 (5.8)	-0.0329 (-3.2)
HMOPOP#	-0.0078 (-5.1)	-0.0089 (-4.2)	-0.0111 (-3.6)	-0.0121 (-13.6)	-0.0124 (-9.6)	-0.0076 (-3.9)
NBEDPOP	-43.5278 (-10.1)	-43.2818 (-4.9)	-21.1405 (-5.1)			
NBEDPOP#	-30.1604 (-6.6)	-50.2309 (-5.3)	-23.4907 (-5.5)			
R^2	0.58	0.63	0.48	0.88	0.88	0.84
N	7896	3768	4128	7896	3768	4128

TABLE 7.8

HHA VISITS IN 30-DAY POSTDISCHARGE PERIOD
FOR HOSPITAL ADMISSION
Waivered and Nonwaivered States

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	-0.4112	-0.3492	0.0627			
	(-8.2)	(-4.2)	(1.1)			
URBAN	0.2230					
	(13.8)					
SPRING	-0.0208	-0.0295	-0.0001	-0.0208	-0.0295	-0.0001
	(-1.5)	(-1.6)	(-0.0)	(-2.9)	(-2.8)	(-0.0)
SUMMER	0.0729	0.0694	0.0812	0.0729	0.0694	0.0812
	(5.4)	(3.7)	(4.8)	(10.1)	(6.6)	(8.7)
AUTUMN	0.1018	0.0987	0.1091	0.1018	0.0987	0.1091
	(7.0)	(4.9)	(6.1)	(13.2)	(8.7)	(10.9)
REGION2	0.2952	0.3581	0.3193			
	(14.1)	(11.8)	(12.4)			
REGION3	0.2745	0.3298	0.2464			
	(13.2)	(10.0)	(11.3)			
REGION4	0.0155	0.0394	-0.1595			
	(0.7)	(0.9)	(-7.3)			
REGION5	-0.3800	-0.4898	-0.1692			
	(-19.1)	(-17.8)	(-6.0)			
AUT86DUM	-0.2013	-0.2381	-0.1129	-0.2013	-0.2381	-0.1129
	(-6.9)	(-5.9)	(-3.1)	(-12.9)	(-10.5)	(-5.6)
DYR82	0.4352	0.5119	0.3517	0.3138	0.2810	0.2574
	(8.5)	(6.5)	(3.5)	(13.4)	(8.2)	(4.8)
DYR83	0.0334	0.0305	-0.0117	0.0594	0.0422	0.0513
	(0.8)	(0.6)	(-0.1)	(2.6)	(1.4)	(1.0)
DYR84	0.0680	0.1256	0.3063	0.0143	0.1578	0.2730
	(1.2)	(1.4)	(2.9)	(0.5)	(3.2)	(4.6)
DYR85	0.1608	0.1744	0.2238	0.2474	0.2331	0.3530
	(2.5)	(1.9)	(2.1)	(7.3)	(4.6)	(5.9)
DYR86	-0.1043	-0.1112	-0.4247	-0.0239	-0.0283	0.0522
	(-1.7)	(-1.5)	(-2.0)	(-0.7)	(-0.7)	(0.4)
BENPOP	0.1020	0.1313	0.0170	-0.1435	-0.1600	-0.1258
	(49.4)	(44.6)	(6.1)	(-10.8)	(-7.7)	(-7.9)
HBEDPOP	-139.047	-217.5560	-8.3272	49.9960	-21.4636	141.4697
	(-21.9)	(-22.6)	(-1.2)	(2.0)	(-0.5)	(5.4)
HBEDPOP#	-3.7636	-5.5205	-18.5788	-9.3572	-2.7126	-36.1771
	(-0.4)	(-0.4)	(-1.7)	(-1.9)	(-0.3)	(-6.0)
PHYSPOP	326.5280	420.7250	322.3100	123.6356	472.4289	-46.1385
	(21.2)	(18.5)	(10.2)	(2.3)	(3.2)	(-1.0)
PHYSPOP#	31.8374	5.5420	-112.2490	54.6918	-5.9463	-53.5295
	(1.9)	(0.2)	(-2.8)	(6.0)	(-0.4)	(-2.3)

TABLE 7.8 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0155 (12.2)	0.0135 (8.0)	0.0254 (10.9)	0.0205 (9.9)	0.0153 (5.6)	-0.0299 (-3.4)
HMOPOP#	-0.0069 (-4.4)	-0.0073 (-3.3)	-0.0109 (-3.5)	-0.0116 (-12.9)	-0.0117 (-8.9)	-0.0077 (-4.0)
NBEDPOP	-38.7364 (-8.8)	-29.0424 (-3.3)	-21.5252 (-5.1)			
NBEDPOP#	-28.7697 (-6.1)	-42.0077 (-4.4)	-23.3853 (-5.4)			
WAIVER	-0.0143 (-0.4)	-0.1524 (-3.4)	0.1450 (2.0)			
MANY86	0.1893 (2.9)	0.2044 (2.6)	0.5725 (2.7)	0.1051 (2.8)	0.1194 (2.5)	0.0519 (0.4)
(1-WAIVER)DYR82	-0.0961 (-2.1)	-0.1286 (-2.2)	0.0019 (0.0)	-0.1261 (-5.1)	-0.1121 (-3.4)	-0.0708 (-1.3)
(1-WAIVER)DYR83	0.1015 (2.2)	0.1228 (2.1)	0.1015 (1.0)	0.1097 (4.5)	0.1446 (4.5)	0.0627 (1.2)
(1-WAIVER)DYR84	0.1195 (2.5)	0.1101 (1.9)	0.0181 (0.2)	0.1663 (6.6)	0.1345 (4.0)	0.0308 (0.6)
(1-WAIVER)DYR85	0.0511 (1.1)	0.0660 (1.2)	0.0414 (0.4)	0.0553 (2.3)	0.0755 (2.4)	0.0271 (0.5)
(1-WAIVER)DYR86	0.1646 (2.6)	0.1620 (2.1)	0.5107 (2.4)	0.1230 (3.5)	0.1165 (2.6)	0.0632 (0.5)
R^2	0.57	0.59	0.47	0.88	0.88	0.84
N	8376	4032	4344	8376	4032	4344

TABLE 7.9

FRACTION OF MEDICARE HOSPITAL STAYS
FOLLOWED BY HHA CARE
Nonwaivered States Only

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0251 (6.4)	0.0314 (4.8)	0.0413 (7.9)			
URBAN	0.0047 (3.7)					
SPRING	-0.0018 (-1.6)	-0.0025 (-1.6)	-0.0005 (-0.3)	-0.0018 (-3.3)	-0.0025 (-3.2)	-0.0005 (-0.6)
SUMMER	0.0058 (5.2)	0.0053 (3.4)	0.0067 (4.4)	0.0058 (10.6)	0.0053 (6.9)	0.0067 (8.6)
AUTUMN	0.0105 (8.7)	0.0100 (6.0)	0.0014 (7.0)	0.0105 (17.9)	0.0100 (12.1)	0.0114 (13.6)
REGION2	0.0115 (5.4)	0.0129 (3.5)	0.0194 (8.5)			
REGION3	0.0016 (1.0)	0.0020 (0.8)	0.0025 (1.3)			
REGION4	-0.0071 (-4.1)	-0.0072 (-2.4)	-0.0182 (-9.4)			
REGION5	-0.0278 (-18.1)	-0.0338 (-16.4)	-0.0202 (-8.1)			
AUT86DUM	-0.0129 (-5.3)	-0.0142 (-4.2)	-0.0103 (-3.2)	-0.0129 (-11.0)	-0.0142 (-8.6)	-0.0104 (-6.1)
DYR82	0.0207 (7.4)	0.0224 (4.7)	0.0269 (7.1)	0.0169 (23.0)	0.0143 (11.7)	0.0196 (19.6)
DYR83	0.0117 (8.4)	0.0129 (6.6)	0.0090 (4.8)	0.0144 (20.4)	0.0155 (13.9)	0.0108 (10.8)
DYR84	0.0208 (8.2)	0.0201 (4.2)	0.0243 (6.6)	0.0203 (16.2)	0.0228 (9.3)	0.0244 (12.6)
DYR85	0.0205 (5.2)	0.0187 (2.9)	0.0263 (5.6)	0.0247 (12.7)	0.0210 (6.6)	0.0327 (13.1)
DYR86	0.0031 (-5.3)	0.0029 (1.4)	0.0044 (2.2)	0.0054 (7.4)	0.0050 (4.8)	0.0065 (6.1)
BENPOP	0.0051 (31.6)	0.0066 (29.7)	-0.0001 (-0.5)	-0.0093 (-9.7)	-0.0095 (-6.7)	-0.0102 (-7.7)
HBEDPOP	-9.1657 (-18.4)	-13.9701 (-19.1)	-0.6591 (-1.1)	1.4875 (0.8)	-4.4650 (-1.6)	9.1524 (4.0)
HBEDPOP#	-1.3765 (-1.9)	-0.9615 (-0.9)	-2.5525 (-2.7)	-1.5053 (-4.2)	-0.6127 (-1.1)	-3.4710 (-6.9)
PHYSPOP	29.9819 (24.1)	32.9940 (18.5)	35.6873 (12.6)	5.0240 (1.3)	25.0812 (2.5)	-2.6008 (-0.7)
PHYSPOP#	-1.2914 (-1.0)	-1.1657 (-0.5)	-3.7332 (-1.0)	0.3734 (0.5)	-1.4601 (-1.3)	-1.4714 (-0.8)

TABLE 7.9 (continued)

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0011	0.0009	0.0014	0.0010	0.0009	-0.0018
	(10.8)	(7.2)	(6.9)	(6.4)	(4.5)	(-2.1)
HMOPOP#	-0.0002	-0.0002	-0.0002	-0.0003	-0.0003	0.0001
	(-1.6)	(-1.1)	(-0.6)	(-5.5)	(-3.8)	(0.6)
NBEDPOP	-2.7688	-2.3703	-1.3142			
	(-8.1)	(-3.4)	(-3.5)			
NBEDPOP#	-1.0361	-1.8232	-1.1833			
	(-2.9)	(-2.4)	(-3.1)			
R^2	0.52	0.54	0.46	0.89	0.89	0.86
N	7896	3768	4128	7896	3768	4128

TABLE 7.10

FRACTION OF MEDICARE HOSPITAL ADMISSIONS FOLLOWED BY HHA CARE
Waivered and Nonwaivered States

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0220 (5.6)	0.0211 (3.3)	0.0051 (8.0)			
URBAN	0.0086 (6.8)					
SPRING	-0.0020 (-1.9)	-0.0026 (-1.8)	-0.0006 (-0.4)	-0.0020 (-3.9)	-0.0026 (-3.6)	-0.0006 (-0.7)
SUMMER	0.0058 (5.4)	0.0055 (3.8)	0.0064 (4.3)	0.0058 (11.2)	0.0055 (7.7)	0.0064 (8.4)
AUTUMN	0.0099 (8.7)	0.0094 (6.0)	0.0109 (6.9)	0.0099 (18.0)	0.0094 (12.4)	0.0109 (13.3)
REGION2	0.0121 (7.4)	0.0155 (6.6)	0.0185 (8.1)			
REGION3	0.0008 (0.5)	0.0035 (1.4)	0.0025 (1.3)			
REGION4	-0.0084 (-4.6)	-0.0051 (-1.6)	-0.0181 (-9.4)			
REGION5	-0.0252 (-16.1)	-0.0290 (-13.6)	-0.0203 (-8.2)			
AUT86DUM	-0.0137 (-6.0)	-0.0151 (-4.8)	-0.0105 (-3.3)	-0.0137 (-12.4)	-0.0151 (-9.8)	-0.0105 (-6.4)
DYR82	0.0260 (6.5)	0.0294 (4.8)	0.0288 (3.3)	0.0241 (14.4)	-0.0221 (9.5)	-0.0256 (5.8)
DYR83	0.0043 (1.3)	0.0045 (1.1)	-0.0006 (-0.1)	0.0068 (4.2)	0.0061 (2.9)	0.0044 (1.0)
DYR84	0.0133 (3.0)	0.0129 (1.9)	0.0151 (1.6)	0.0102 (4.7)	0.0156 (4.6)	0.0146 (3.0)
DYR85	0.0131 (2.6)	0.0095 (1.3)	0.0238 (2.5)	0.0181 (7.6)	0.0131 (3.8)	0.0317 (6.4)
DYR86	-0.0015 (-0.3)	0.0005 (0.1)	-0.0448 (-2.4)	0.0035 (1.5)	0.0038 (1.3)	-0.0026 (-0.3)
BENPOP	0.0051 (31.3)	0.0069 (30.4)	-0.0000 (-0.0)	-0.0096 (-10.1)	-0.0096 (-6.9)	-0.0107 (-8.1)
HBEDPOP	-7.973 (-16.0)	-12.54 (-16.9)	-0.5999 (-1.0)	3.633 (2.1)	-0.6977 (-0.3)	9.668 (4.5)
HBEDPOP#	-1.133 (-1.5)	-0.4921 (-0.4)	-2.557 (-2.7)	-1.386 (-3.9)	-0.3584 (-0.6)	-3.567 (-7.2)
PHYSPOP	24.79 (20.6)	27.92 (15.9)	33.68 (12.1)	4.983 (1.3)	21.00 (2.1)	-2.633 (-0.7)
PHYSPOP#	-1.227 (-0.9)	-0.9242 (-0.4)	-4.481 (-1.3)	0.3807 (0.6)	-1.796 (-1.6)	-1.766 (-0.9(

TABLE 7.10 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0011 (11.5)	0.0009 (7.3)	0.0016 (7.8)	0.0009 (5.9)	0.0008 (4.1)	-0.0022 (-3.0)
HMOPOP#	-0.0001 (-1.0)	-0.0001 (-0.4)	-0.0002 (-0.7)	-0.0003 (-5.1)	-0.0003 (-3.3)	0.0001 (0.8)
NBEDPOP	-2.466 (-7.2)	-1.170 (-1.7)	-1.346 (-3.6)			
NBEDPOP#	(-1.010 (-2.8)	-1.670 (-2.3)	-1.193 (-3.1)			
WAIVER	0.0066 (2.4)	-0.0023 (-0.7)	0.0232 (3.7)			
MANY86	0.0076 (1.5)	0.0062 (1.0)	0.0468 (2.5)	0.0023 (0.9)	0.0034 (1.1)	0.0005 (0.1)
(1-WAIVER)DYR82	-0.0052 (-1.4)	-0.0076 (-1.7)	-0.0018 (-0.2)	-0.0071 (-4.0)	-0.0074 (-3.3)	-0.0059 (-1.3)
(1-WAIVER)DYR83	0.0076 (2.1)	0.0087 (2.0)	0.0095 (1.1)	0.0078 (4.5)	0.0098 (4.5)	0.0064 (1.4)
(1-WAIVER)DYR84	0.0074 (2.0)	0.0068 (1.5)	0.0098 (1.1)	0.0104 (5.8)	0.0083 (3.7)	0.0102 (2.5)
(1-WAIVER)DYR85	0.0058 (1.6)	0.0058 (1.3)	0.0025 (0.3)	0.0061 (3.5)	0.0065 (3.0)	0.0016 (0.4)
(1-WAIVER)DYR86	0.0048 (1.0)	0.0026 (0.4)	0.0492 (2.6)	0.0022 (0.9)	0.0014 (0.5)	0.0092 (0.8)
R^2	0.52	0.52	0.46	0.89	0.89	0.86
N	8376	4032	4344	8376	4032	4344

TABLE 7.11

QUARTERLY SNF ADMISSIONS PER ENROLLEE
Nonwaivered States Only

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0020 (13.3)	0.0026 (11.3)	0.0029 (13.0)			
URBAN	0.0005 (10.1)					
SPRING	-0.0001 (-1.8)	-0.0009 (-1.5)	-0.0006 (-0.9)	-0.0001 (-2.8)	-0.0009 (-2.6)	-0.0006 (-1.3)
SUMMER	-0.0002 (-4.7)	-0.0003 (-4.5)	-0.0001 (-1.6)	-0.0002 (-7.5)	-0.0003 (-7.6)	-0.0001 (-2.4)
AUTUMN	-0.0001 (-2.4)	-0.0002 (-2.9)	0.00002 (0.3)	-0.0001 (-3.7)	-0.0002 (-4.8)	0.00002 (0.4)
REGION2	-0.0012 (-14.5)	-0.0013 (-9.8)	-0.0011 (-11.2)			
REGION3	-0.0016 (-26.8)	-0.0015 (-17.1)	-0.0019 (-23.5)			
REGION4	0.0003 (5.0)	0.0004 (3.8)	0.0003 (3.4)			
REGION5	0.0006 (10.6)	0.0008 (10.4)	-0.00003 (-0.3)			
AUT86DUM	-0.0004 (-4.0)	-0.0004 (-3.0)	-0.0004 (-2.8)	-0.0004 (-6.4)	-0.0004 (-5.1)	-0.0004 (-4.2)
DYR82	-0.0001 (-1.4)	0.0005 (2.7)	-0.0005 (-3.1)	0.0002 (5.9)	0.0003 (5.7)	0.0001 (2.4)
DYR83	0.0001 (1.7)	0.00009 (1.3)	0.0001 (1.8)	0.0002 (5.5)	0.0002 (4.0)	0.0002 (3.9)
DYR84	0.0013 (12.7)	0.0004 (2.2)	0.0015 (9.3)	0.0012 (18.9)	0.0004 (4.1)	0.0013 (12.3)
DYR85	-0.0004 (-2.8)	-0.0009 (-3.8)	-0.0008 (-4.2)	-0.0004 (-4.1)	-0.0009 (-6.4)	-0.0005 (-3.8)
DYR86	-0.0002 (-4.4)	-0.0004 (-4.9)	0.000004 (0.04)	-0.0002 (-5.7)	-0.0003 (-7.8)	0.0001 (1.7)
BENPOP	0.00002 (4.2)	0.00004 (5.3)	-0.00004 (-3.5)	-0.0003 (-5.6)	-0.0001 (-1.8)	-0.0005 (-7.4)
HBEDPOP	-0.0858 (-4.4)	-0.0399 (-1.5)	-0.2027 (-7.3)	-0.6164 (-6.8)	-0.3648 (-3.0)	-0.7481 (-5.8)
HBEDPOP#	0.1187 (4.2)	+0.1164 (2.9)	0.3224 (7.8)	0.1374 (7.7)	0.1305 (5.4)	0.2909 (10.3)
PHYSPOP	0.3851 (8.0)	0.0678 (1.1)	0.5373 (4.4)	-0.4776 (-2.5)	-1.1250 (-2.5)	-0.2894 (-1.4)
PHYSPOP#	-0.6502 (-12.0)	-0.1511 (-1.8)	-1.0876 (-7.0)	-0.5581 (-16.4)	-0.1508 (-3.0)	-0.8512 (-7.8)

TABLE 7.11 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.00004 (9.6)	0.00002 (4.4)	0.0001 (12.3)	-0.0001 (-7.6)	-0.00002 (-2.9)	-0.0002 (-4.6)
HMOPOP#	0.000004 (0.8)	0.00003 (4.4)	0.00003 (2.5)	0.00001 (4.5)	0.00003 (8.4)	0.00005 (5.4)
NBEDPOP	-0.0136 (-1.0)	0.0091 (0.4)	0.0227 (1.4)			
NBEDPOP#	0.0402 (2.9)	-0.0464 (-1.7)	0.0622 (3.8)			
R^2	0.31	0.29	0.34	0.73	0.76	0.72
N	7896	3768	4128	7896	3768	4128

TABLE 7.12

QUARTERLY MEDICARE SNF ADMISSIONS PER ENROLLEE
Waivered and Nonwaivered States

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0022 (15.0)	0.0030 (13.4)	0.0031 (14.2)			
URBAN	0.0005 (11.3)					
SPRING	-0.0001 (-2.1)	-0.0001 (-1.9)	-0.0001 (-1.0)	-0.0001 (-3.4)	-0.0001 9-3.2)	-0.0001 (-1.5)
SUMMER	-0.0002 (-5.7)	-0.0003 (-5.5)	-0.0001 (-1.8)	-0.0002 (-9.18)	-0.0003 (-9.3)	-0.0001 (-2.7)
AUTUMN	-0.0001 (-3.1)	-0.0002 (-3.5)	0.0000 (0.1)	-0.0001 (-4.9)	-0.0002 (-6.0)	0.0000 (0.2)
REGION2	-0.0007 (-11.6)	-0.0006 (-7.1)	-0.0011 (-11.5)			
REGION3	-0.0016 (-26.5)	-0.0015 (-17.0)	-0.0020 (-24.2)			
REGION4	0.0004 (5.7)	0.0004 (4.1)	0.0002 (2.9)			
REGIONS5	0.0007 (11.5)	0.0008 (10.2)	0.0000 (0.3)			
AUT86DUM	-0.0003 (-3.9)	-0.0003 (-3.0)	-0.0004 (-2.6)	-0.0003 (-6.3)	-0.0003 (-5.2)	-0.0004 (-3.9)
DYR82	-0.0002 (-1.3)	0.0004 (1.8)	-0.0006 (-1.6)	0.0002 (2.8)	0.0003 (3.1)	-0.0000 (-0.0)
DYR83	0.0000 (0.1)	0.0000 (0.2)	0.0001 (0.4)	0.0001 (1.6)	0.0001 (1.6)	0.0003 (1.2)
DYR84	0.0010 (6.1)	-0.0001 (-0.4)	0.0011 (2.8)	0.0011 (10.3)	0.0001 (0.6)	0.0012 (4.4)
DYR85	-0.0006 (-3.4)	-0.0008 (-3.4)	-0.0016 (-4.0)	-0.0007 (-5.9)	-0.0009 (-6.4)	-0.0014 (-5.0)
DYR86	-0.0002 (-1.0)	-0.0002 (-1.2)	0.0003 (0.4)	-0.0004 (-3.5)	-0.0004 (-3.0)	-0.0004 (-0.6)
BENPOP	0.0000 (4.0)	0.0000 (5.8)	-0.0001 (-5.5)	-0.0003 (-6.3)	-0.0001 (-2.3)	-0.0005 (-7.3)
HBEDPOP	-0.0736 (-3.9)	-0.0531 (-2.1)	-0.1773 (-6.6)	-0.5465 (-6.5)	-0.3397 (-3.0)	-0.6194 (-5.4)
HBEDPOP#	0.1056 (3.8)	0.1037 (2.7)	0.3131 (7.8)	0.1320 (7.6)	0.1281 (5.5)	0.3021 (11.0)
PHYSPOP	0.2616 (5.8)	-0.0185 (-0.3)	0.5073 (4.3)	-0.5186 (-2.7)	-1.154 (-2.8)	-0.2843 (-1.4)
PHYSPOP#	-0.5463 (-11.1)	-0.0585 (-0.8)	-1.081 (-7.2)	-0.5153 (-16.4)	-0.1070 (-2.3)	-0.9142 (-8.7)

TABLE 7.13

COVERED SNF DAYS IN 30-DAY POST DISCHARGE PERIOD PER HOSPITAL ADMISSION
Nonwaivered States Only

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.3041 (10.3)	0.4333 (8.7)	0.4973 (13.1)			
URBAN	0.1759 (18.4)					
SPRING	-0.0068 (-0.8)	-0.0151 (-1.3)	0.0097 (0.9)	-0.0069 (-1.3)	-0.0151 (-2.0)	0.0097 (1.3)
SUMMER	-0.0051 (-0.6)	-0.0188 (-1.6)	0.0221 (2.0)	-0.0051 (-1.0)	-0.0188 (-2.5)	0.0221 (2.9)
AUTUMN	0.0022 (0.2)	-0.0105 (-0.8)	0.0274 (2.3)	0.0022 (0.4)	-0.0105 (-1.3)	0.0274 (3.4)
REGION2	-0.2871 (-17.9)	-0.2928 (-10.5)	-0.2589 (-15.6)			
REGION3	-0.3252 (-27.3)	-0.3042 (-16.3)	-0.3493 (-25.1)			
REGION4	0.0657 (5.0)	0.1144 (4.9)	0.0367 (2.6)			
REGION5	0.0862 (7.5)	0.1178 (7.4)	-0.0160 (-0.9)			
AUT86DUM	-0.1130 (-6.2)	-0.1283 (-5.0)	-0.0821 (-3.4)	-0.1130 (-9.8)	-0.1283 (-8.1)	-0.0821 (-5.0)
DYR82	-0.0034 (-0.2)	0.1046 (2.8)	-0.0641 (-2.3)	0.0450 (6.2)	0.0713 (6.1)	0.0174 (1.8)
DYR83	0.0024 (0.2)	-0.0006 (-0.04)	0.0174 (1.3)	0.0269 (3.9)	0.0318 (3.0)	0.0286 (3.0)
DYR84	0.1762 (9.2)	0.0364 (1.0)	0.1643 (6.1)	0.1640 (13.3)	0.0518 (2.2)	0.1436 (7.7)
DYR85	-0.0207 (-0.7)	-0.0781 (-1.6)	-0.1010 (-3.0)	-0.0123 (-0.6)	-0.0894 (-2.9)	-0.0631 (-2.6)
DYR86	-0.0626 (-5.6)	-0.0856 (-5.4)	-0.0136 (-0.9)	-0.0498 (-6.9)	-0.0739 (-7.5)	0.0025 (0.3)
BENPOP	0.0135 (11.3)	0.0192 (11.3)	-0.0027 (-1.5)	-0.0772 (-8.1)	-0.0774 (-5.6)	-0.0828 (-6.5)
HBEDPOP	-43.9022 (-11.7)	-36.4293 (-6.5)	-58.4127 (-12.4)	-129.9666 (-7.3)	-117.0262 (-4.4)	-102.3106 (-4.6)
HBEDPOP#	5.7799 (1.1)	3.7127 (0.4)	39.8024 (5.7)	10.0405 (2.9)	11.2004 (2.1)	36.3209 (7.5)
PHYSPOP	124.5940 (13.4)	65.1437 (4.8)	169.0710 (8.2)	-109.0398 (-2.9)	-305.9067 (-3.1)	-57.2375 (-1.6)
PHYSPOP#	-100.6250 (-9.9)	-20.3911 (-1.2)	-111.5090 (-4.2)	-82.1450 (-12.3)	-22.5744 (-2.0)	-77.8986 (-4.2)

TABLE 7.12 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0000 (9.7)	0.0000 (4.9)	0.0001 (12.0)	-0.0001 (-7.5)	-0.0000 (-3.0)	-0.0001 (-2.9)
HMOPOP#	-0.0000 (-0.2)	0.0000 (3.7)	0.0000 (2.4)	0.0000 (4.2)	0.0000 (8.4)	0.0000 (4.9)
NBEDPOP	-0.0312 (-2.4)	-0.0246 (-1.0)	-.0249 (1.6)			
NBEDPOP#	0.0419 (3.1)	-0.0419 (-1.6)	0.0623 (3.8)			
WAIVER	-0.0010 (-9.9)	-0.0010 (-8.4)	-0.0005 (-1.8)			
MANY86	0.0003 (1.6)	0.0004 (1.8)	-0.0000 (-0.0)	0.0007 (5.3)	0.0006 (4.3)	0.0008 (1.3)
(1-WAIVER)DYR82	0.0000 (0.3)	0.0001 (0.4)	0.0001 (0.3)	-0.0000 (-0.0)	0.0000 (0.0)	0.0001 (0.5)
(1-WAIVER)DYR83	0.0001 (0.7)	0.0001 (0.4)	0.0000 (0.1)	0.0001 (0.8)	0.0001 (0.7)	-0.0001 (-0.3)
(1-WAIVER)DYR84	0.0001 (0.5)	0.0003 (1.9)	0.0004 (1.0)	0.0001 (0.7)	0.0003 (3.0)	0.0002 (0.8)
(1-WAIVER)DYR85	0.0003 (2.3)	0.0000 (0.2)	0.0008 (2.2)	0.0003 (3.8)	0.0000 (0.4)	0.0008 (3.1)
(1-WAIVER)DYR86	-0.0001 (-0.4)	-0.0001 (-0.6)	-0.0003 (-0.4)	0.0002 (1.6)	-0.0000 (-0.0)	0.0005 (0.8)
R^2	0.33	0.39	0.34	0.74	0.80	0.72
N	8376	4032	4344	8376	4032	4344

TABLE 7.13 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0042 (5.6)	0.0012 (1.3)	0.0174 (11.5)	-0.0116 (-7.7)	-0.0058 (-3.2)	-0.0149 (-1.8)
HMOPOP#	0.0040 (4.4)	0.0075 (5.9)	0.0073 (3.6)	0.0055 (8.7)	0.0079 (9.3)	0.0083 (5.4)
NBEDPOP	0.0660 (0.03)	12.2221 (2.3)	4.3586 (1.6)			
NBEDPOP#	3.2782 (1.2)	-12.2643 (-2.1)	7.2463 (2.6)			
R^2	0.38	0.30	0.38	0.76	0.74	0.72
N	7896	3768	4128	7896	3768	4128

TABLE 7.14

COVERED SNF DAYS IN 30-DAY POST DISCHARGE PERIOD PER HOSPITAL ADMISSION
Waivered and Nonwaivered States

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.3504	0.5179	0.5365			
	(12.1)	(10.8)	(14.5)			
URBAN	0.1845					
	(19.9)					
SPRING	-0.0110	-0.0187	0.0073	-0.0110	-0.0187	0.0073
	(-1.4)	(-1.7)	(0.7)	(-2.3)	(-2.9)	(1.0)
SUMMER	-0.0110	-0.0239	0.0197	-0.0110	-0.0239	0.0197
	(-1.4)	(-2.2)	(1.8)	(-2.3)	(-3.6)	(2.7)
AUTUMN	-0.0032	-0.0149	0.0247	-0.0032	-0.0149	0.0247
	(-0.4)	(-1.3)	(2.2)	(-0.6)	(-2.1)	(3.2)
REGION2	-0.1585	-0.1001	-0.2602			
	(-13.1)	(-5.8)	(-15.9)			
REGION3	-0.3168	-0.2975	-0.3538			
	(-26.5)	(-15.9)	(-25.6)			
REGION4	0.0757	0.1228	0.0268			
	(5.7)	(5.2)	(1.9)			
REGION5	0.0955	0.1084	-0.0022			
	(8.3)	(6.9)	(-0.1)			
AUT86DUM	-0.1119	-0.1266	-0.0767	-0.1119	-0.1266	-0.0767
	(-6.7)	(-5.5)	(-3.3)	(-10.6)	(-9.0)	(-4.9)
DYR82	-0.0264	0.0733	-0.0783	0.0380	0.0631	-0.0032
	(-0.9)	(1.6)	(-1.2)	(2.4)	(3.0)	(-0.1)
DYR83	-0.0132	-0.0099	-0.0040	0.0140	0.0221	0.0207
	(-0.5)	(-0.3)	(-0.1)	(0.9)	(1.2)	(0.5)
DYR84	0.1480	-0.0483	0.1439	0.1543	0.0019	0.1420
	(4.5)	(-1.0)	(2.1)	(7.5)	(0.1)	(3.1)
DYR85	-0.0843	-0.1020	-0.2299	-0.0902	-0.1302	-0.2024
	(-2.3)	(-2.0)	(-3.4)	(-4.0)	(-4.1)	(-4.3)
DYR86	-0.0344	-0.0472	-0.0512	-0.0870	-0.0620	-0.1874
	(-1.0)	(-1.1)	(-0.4)	(-3.8)	(-2.3)	(-1.9)
BENPOP	0.0135	0.0204	-0.0069	-0.0783	-0.0751	-0.0797
	(11.3)	(12.1)	(-3.9)	(-8.7)	(-5.8)	(-6.4)
HBEDPOP	-39.6603	-38.8813	-52.6539	-111.7977	-105.2372	-86.3983
	(-10.8)	(-7.1)	(-11.6)	(-6.7)	(-4.2)	(-4.3)
HBEDPOP#	5.0404	2.4976	39.2312	10.4580	11.8027	38.2717
	(0.9)	(0.3)	(5.7)	(3.1)	(2.3)	(8.1)
PHYSPOP	92.6084	42.9998	161.2650	-117.3762	-307.4919	-57.2858
	(10.5)	(3.3)	(8.0)	(-3.2)	(-3.3)	(-1.7)
PHYSPOP#	-84.4525	-0.7599	-115.1900	-77.9748	-16.7466	-90.5797
	(-8.7)	(-0.05)	(-4.5)	(-12.6)	(-1.6)	(-5.1)

TABLE 7.14 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0047	0.0022	0.0164	-0.0106	-0.0055	-0.0044
	(6.4)	(2.3)	(11.1)	(-7.6)	(-3.3)	(-0.6)
HMOPOP#	0.0031	0.0065	0.0069	0.0052	0.0078	0.0079
	(3.4)	(5.2)	(3.5)	(8.6)	(9.4)	(5.3)
NBEDPOP	-4.5146	3.2915	4.7864			
	(-1.8)	(0.7)	(1.8)			
NBEDPOP#	3.5494	-11.1174	7.1254			
	(1.3)	(-2.0)	(2.6)			
WAIVER	-0.2060	-0.2223	-0.1006			
	(-10.3)	(-8.7)	(-2.2)			
MANY86	0.0603	0.0827	0.0804	0.1474	0.1170	0.2414
	(1.6)	(1.8)	(0.6)	(5.9)	(4.0)	(2.4)
(1-WAIVER)DYR82	0.0232	0.0258	0.0160	0.0076	0.0082	0.0197
	(0.8)	(0.8)	(0.3)	(0.5)	(0.4)	(0.5)
(1-WAIVER)DYR83	0.0166	0.0094	0.0221	0.0133	0.0097	0.0069
	(0.6)	(0.3)	(0.4)	(0.8)	(0.5)	(0.2)
(1-WAIVER)DYR84	0.0025	0.0453	0.0246	0.0036	0.0392	0.0121
	(0.09)	(1.3)	(0.4)	(0.2)	(1.9)	(0.3)
(1-WAIVER)DYR85	0.0731	0.0378	0.1331	0.0761	0.0389	0.1276
	(2.8)	(1.2)	(2.2)	(4.7)	(2.0)	(3.1)
(1-WAIVER)DYR86	-0.0286	-0.0390	0.0370	0.0372	-0.0126	0.1881
	(-0.8)	(-0.9)	(0.3)	(1.6)	(-0.5)	(1.9)
R^2	0.38	0.36	0.37	0.77	0.77	0.72
N	8376	4032	4344	8376	4032	4344

TABLE 7.15

FRACTION OF MEDICARE HOSPITAL ADMISSIONS
FOLLOWED BY SNF CARE

Nonwaivered States Only

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0164 (10.1)	0.0235 (9.1)	0.0252 (11.1)			
URBAN	0.0071 (13.5)					
SPRING	-0.0004 (-0.9)	-0.0007 (-1.1)	0.0001 (0.2)	-0.0004 (-1.3)	-0.0007 (-1.8)	0.0001 (0.3)
SUMMER	-0.0001 (-0.3)	-0.0008 (-1.3)	0.0012 (1.8)	-0.0001 (-0.5)	-0.0008 (-2.1)	0.0012 (2.5)
AUTUMN	0.0010 (2.0)	0.0002 (0.3)	0.0025 (3.6)	0.0010 (3.1)	0.0002 (0.6)	0.0025 (5.1)
REGION2	-0.0119 (-13.5)	-0.0120 (-8.3)	-0.0110 (-11.1)			
REGION3	-0.0161 (-24.7)	-0.0147 (-15.2)	-0.0186 (-22.4)			
REGION4	0.0075 (10.4)	0.0103 (8.5)	0.0055 (6.5)			
REGION5	0.0104 (16.4)	0.0120 (14.5)	0.0039 (3.6)			
AUT86DUM	-0.0069 (-6.9)	-0.0073 (-5.5)	-0.0060 (-4.2)	-0.0069 (-10.6)	-0.0073 (-9.1)	-0.0060 (-5.9)
DYR82	-0.0029 (-2.5)	0.0042 (2.2)	-0.0066 (-4.0)	0.0019 (4.6)	0.0030 (5.0)	0.0009 (1.5)
DYR83	0.0005 (0.8)	0.0005 (0.6)	0.0010 (1.3)	0.0018 (4.7)	0.0022 (4.1)	0.0016 (2.7)
DYR84	0.0143 (13.7)	0.0054 (2.8)	0.0144 (9.0)	0.0135 (19.6)	0.0059 (4.9)	0.0134 (11.5)
DYR85	-0.0021 (-1.3)	-0.0073 (-2.9)	-0.0069 (-3.4)	-0.0020 (-1.9)	-0.0078 (-5.0)	-0.0054 (-3.6)
DYR86	-0.0015 (-2.4)	-0.0028 (-3.4)	0.0013 (1.5)	-0.0010 (-2.4)	-0.0024 (-4.7)	0.0021 (3.2)
BENPOP	0.0006 (8.4)	0.0008 (8.8)	-0.0001 (-1.2)	-0.0033 (-6.2)	-0.0030 (-4.2)	-0.0040 (-5.1)
HBEDPOP	-2.3845 (-11.6)	-2.0255 (-6.9)	-3.3574 (-11.9)	-8.9842 (-9.0)	-6.7870 (-5.0)	-9.2088 (-6.7)
HBEDPOP#	1.0882 (3.6)	1.0851 (2.5)	3.4227 (8.2)	1.3770 (7.0)	1.4231 (5.3)	3.3517 (11.1)
PHYSPOP	6.5403 (12.8)	2.9913 (4.2)	8.4412 (6.9)	-8.5239 (-4.0)	-19.2204 (-3.9)	-5.1136 (-2.3)
PHYSPOP#	-7.3082 (-13.1)	-2.0811 (-2.3)	-9.4870 (-6.0)	-6.2165 (-16.7)	-2.0434 (-3.6)	-7.9705 (-6.9)

TABLE 7.15 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0004	0.0002	0.0012	-0.0007	-0.0003	-0.0010
	(9.4)	(3.9)	(12.9)	(-7.9)	(-2.8)	(-1.9)
HMOPOP#	0.0002	0.0005	0.0005	0.0003	0.0005	0.0006
	(4.6)	(7.3)	(4.5)	(9.6)	(12.1)	(6.7)
NBEDPOP	0.0306	0.5980	0.2970			
	(0.2)	(2.2)	(1.8)			
NBEDPOP#	0.4848	-0.5631	0.7494			
	(3.3)	(-1.9)	(4.5)			
R^2	0.41	0.39	0.44	0.76	0.79	0.73
N	7896	3768	4128	7896	3768	4128

TABLE 7.16

FRACTION OF MEDICARE HOSPITAL ADMISSIONS
FOLLOWED BY SNF CARE
Waivered and Nonwaivered States

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	0.0189 (11.8)	0.0281 (11.2)	0.0273 (12.4)			
URBAN	0.0076 (14.9)					
SPRING	-0.0007 (-1.5)	-0.0009 (-1.7)	0.0000 (0.0)	-0.0007 (-2.4)	-0.0009 (-2.8)	0.0000 (0.0)
SUMMER	-0.0006 (-1.3)	-0.0012 (-2.2)	0.0010 (1.6)	-0.0006 (-2.1)	-0.0012 (-3.7)	0.0010 (2.2)
AUTUMN	0.0006 (1.2)	-0.0002 (-0.3)	0.0023 3.4)	0.0006 (2.0)	-0.0002 (-0.5)	0.0023 (4.8)
REGION2	-0.0069 (-10.4)	-0.0051 (-5.6)	-0.0111 (-11.4)			
REGION3	-0.0159 (-24.1)	-0.0147 (-14.9)	-0.0189 (-22.9)			
REGION4	0.0080 (10.9)	0.0105 (8.5)	0.0049 (5.9)			
REGION5	0.0111 (17.5)	0.0119 (14.4)	0.0047 (4.4)			
AUT86DUM	-0.0066 (-7.2)	-0.0071 (-5.8)	-0.0056 (-4.1)	-0.0066 (-11.3)	-0.0071 (-9.9)	-0.0056 (-5.8)
DYR82	-0.0034 (-2.1)	0.0034 (1.4)	-0.0069 (-1.8)	0.0022 (2.5)	0.0036 (3.3)	-0.0004 (-0.2)
DYR83	-0.0009 (-0.7)	-0.0007 (-0.5)	0.0004 (0.1)	0.0008 (0.9)	0.0011 (1.2)	0.0017 (0.7)
DYR84	0.0120 (6.6)	0.0003 (0.1)	0.0108 (2.7)	0.0125 (10.8)	0.0024 (1.5)	0.0117 (4.1)
DYR85	-0.0073 (-3.6)	-0.0092 (-3.4)	-0.0181 (-4.5)	-0.0081 (-6.4)	-0.0109 (-6.8)	-0.0172 (-5.9)
DYR86	-0.0019 (-1.0)	-0.0025 (-1.1)	0.0033 (0.4)	-0.0038 (-3.0)	-0.0027 (-2.0)	-0.0046 (-0.8)
BENPOP	0.0005 (8.2)	0.0008 (9.1)	-0.0004 (-3.5)	-0.0033 (-6.6)	-0.0027 (-4.2)	-0.0040 (-5.2)
HBEDPOP	-2.1535 (-10.7)	-2.0553 (-7.1)	-3.0214 (-11.2)	-7.9632 (-8.6)	-6.2410 (-4.9)	-8.0465 (-6.4)
HBEDPOP#	0.9490 (3.2)	0.9223 (2.1)	3.3239 (8.2)	1.3300 (7.0)	1.3977 (5.4)	3.4025 (11.7)
PHYSPOP	4.9644 (10.2)	1.8764 (2.8)	8.0093 (6.7)	-8.9864 (-4.3)	-19.2794 (-4.1)	-5.1324 (-2.4)
PHYSPOP#	-6.2755 (-11.8)	-1.1577 (-1.3)	-9.4485 (-6.2)	-5.9024 (-17.1)	-1.7690 (-3.4)	-8.4480 (-7.6)

TABLE 7.16 (continued)

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	0.0004	0.0002	0.0011	-0.0006	-0.0002	-0.0003
	(9.3)	(4.1)	(12.6)	(-7.5)	(-2.8)	(-0.7)
HMOPOP#	0.0002	0.0004	0.0005	0.0003	0.0005	0.0006
	(3.5)	(6.4)	(4.3)	(9.5)	(12.2)	(6.6)
NBEDPOP	-0.1964	0.1263	0.3205			
	(-1.4)	(0.5)	(2.0)			
NBEDPOP#	0.4951	-0.4991	0.7474			
	(3.4)	(-1.7)	(4.5)			
WAIVER	-0.0097	-0.0099	-0.0046			
	(-8.8)	(-7.4)	(-1.7)			
MANY86	0.0042	0.0051	-0.0002	0.0075	0.0058	0.0091
	(2.0)	(2.1)	(-0.0)	(5.4)	(3.9)	(1.5)
(1-WAIVER)DYR82	0.0005	0.0005	0.0004	-0.0003	-0.0006	0.0013
	(0.3)	(0.3)	(0.1)	(-0.4)	(-0.6)	(0.5)
(1-WAIVER)DYR83	0.0014	0.0012	0.0007	0.0011	0.0011	-0.0002
	(1.0)	(0.7)	(0.2)	(1.2)	(1.1)	(-0.1)
(1-WAIVER)DYR84	0.0007	0.0033	0.0036	0.0005	0.0030	0.0021
	(0.5)	(1.9)	(1.0)	(0.6)	(2.9)	(0.8)
(1-WAIVER)DYR85	0.0062	0.0032	0.0117	0.0063	0.0032	0.0114
	(4.3)	(1.9)	(3.2)	(7.0)	(3.2)	(4.4)
(1-WAIVER)DYR86	0.0003	-0.0003	-0.0020	0.0028	0.0003	0.0066
	(0.2)	(-0.1)	(-0.3)	(2.1)	(0.2)	(1.1)
R^2	0.42	0.44	0.43	0.78	0.82	0.73
N	8376	4032	4344	8376	4032	4344

VIII. FINAL REMARKS

PPS and Part A Payments

Estimating the effects of PPS on Medicare payments is even more problematic than estimating its effects on utilization. Prior to the inception of PPS, payment was determined by utilization together with the mix of factor prices and rates of inflation determined at the national and local levels and conditioned by the efficiency and level of quality provided by the individual hospital. Under PPS, the link between utilization and payment is determined entirely by the mechanism of the payment formula. Hence the relationship between economy-wide and health sector price changes and Medicare hospital payments was not uniform during the period under study. Because of the difficulty of discriminating between PPS effects and changes in rates of inflation (particularly the slowing of health care inflation in the mid-eighties), only the double-difference estimators are used here to assess the effects of PPS on Part A payments. Since these rely on contemporaneous comparisons of intertemporal differences, most purely inflationary effects should be eliminated. (Since all waivered states are in the northeast and mid-Atlantic areas, regional differences in inflation rates remain.)

The estimates of PPS effects on Part A payments are presented in Table 8.1. PPS is estimated to have produced clear increases in hospital payments despite the reductions in utilization attributed to PPS in Chapter 6. Payments for HHA care also appear to have increased as a result of PPS. Overall, Part A payments are estimated to have increased by between twelve and thirty-nine dollars per enrollee.

TABLE 8.1

REGRESSION ESTIMATES OF PPS EFFECTS ON QUARTERLY MEDICARE EXPENDITURES

	Part A Payments	Hospital Payments	SNF Payments	HHA Payments
Double Difference				
Estimator 5	\$35.55**	\$33.58**	\$0.21	\$1.77**
Estimator 6	\$12.16*	\$10.66*	\$0.25	\$1.22*
Estimator 7	\$38.77**	\$36.28**	\$0.20	\$2.28**
Estimator 8	\$15.37**	\$13.40**	\$0.25	\$1.73**

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*Estimate significant at 0.10 level (two-sided test).

**Estimate significant at 0.05 level (two-sided test).

HOSPITAL ADMISSIONS
PHC SYNTHESIS
PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED MORTALITY

Because these results are at variance with other evidence suggesting that PPS has generated a significant saving of Medicare funds (see for example, Russell and Manning (1989)), the underpinnings of the double-difference estimates in Table 8.1 should be reiterated. All such estimates rely on the assumption that first or second differences in the dependent variable of interest are expected to be equal in waivered and nonwaivered states, save for differences generated by the Prospective Payment System. This assumption is more stringent when it is applied to payment comparisons than when it is applied to comparisons of utilization, since payments are determined by levels of utilization and by payment rates themselves. The double-difference estimates of Chapter VI produced no evidence of PPS effects on hospital admission rates. Hence the only remaining source for the observed estimates of substantial positive effects on hospital payments must lie in the process of rate setting. If the mean increase in the allowed prospective rates in waivered states in 1984 was below the inflation factor built into hospital prospective rates under PPS, then the PPS effects on hospital payments reported in Table 8.1 could be a simple artifact of differences in the timing of regulatory adjustment to inflation in PPS and waivered states. Nevertheless, the coefficients (1-WAIVER)DYR82 through (1-WAIVER)DYR86 in Table 8.2 indicate that Part A payments per capita had been declining in nonwaivered states relative to waivered states until 1984 and that the relative increase continued in 1985. The decline in relative payment per capita in 1986 was sufficient to offset only a little more than half of the 1985 increase in payments per enrollee in nonwaivered relative to waivered states.

The double-difference estimates of PPS effects on SNF and HHA payments are not subject to the problem of differential rate setting, since payment for these services is determined by HCFA for waivered and nonwaivered states alike. The four estimates of PPS effects on SNF and HHA payment are indeed more consistent with one another than are the estimates for hospital payments and therefore should be regarded as more reliable.

Regression estimates for Part A payments are presented in Table 8.2. Increases in hospital beds per capita and physicians per capita (in urban areas) are associated with statistically significant increases in Part A payments per enrollee. Increases in enrollees and HMO members per 100 population tend to reduce payments per enrollee. Notice also that the regional variation in Part A payments is more compressed in rural than in urban areas: the urban variation is nearly 52 dollars (comparing the omitted region to REGION4) while the rural variation is less than 21 dollars (comparing REGION3 and REGION4).

Directions for Future Research

Several of the issues and results treated in this paper merit further investigation either because of the prospect for better estimates or because particular unexplained empirical results warrant resolution. Three such issues are discussed below.

The Role of Market Variables. The estimated effects of some market variables are opposite in sign in the OLS as opposed to the fixed-effect model. In the case of, say, HMO enrollment, this outcome is easy to understand. In other cases, for example, the effect of the ratio of enrollees or physicians to the population, the result is more puzzling. There are several possibilities: (1) Since levels and changes in a covariate play different roles in OLS and fixed-effect models, varying rates of growth of particular market variables in locations with alternative levels of the variables may cause the shift in sign. If such were the case, the fixed-effect model is likely to be more reliable. (2) The market variables are all measured relative to the area population. If population (the denominator) were measured substantially more accurately in each year than the quantity of the market variable (beds, enrollees, physicians), then both OLS and fixed-effect estimates would be subject to bias. The sign and relative magnitude of the bias has yet to be derived. (3) Finally, the influence of outliers (or "high-leverage observations") has not yet been assessed.

Age Distribution. None of the estimates takes account of the varying age distribution of enrollees in different areas of the country. The analytic file created for per capital analyses contains data on Part A utilization by five-year age groups. A joint analysis of utilization by age group would provide valuable evidence bearing on the oft-made assertions that differences in the age distribution of enrollees accounts for differences in urban-rural and perhaps regional utilization rates.

Substitution of Nonhospital for Hospital Care. This paper has provided only indirect evidence supporting the substitutability of SNF and HHA care for hospital care. Estimation of a three- or four-equation system, including properly specified lagged endogenous cariables could provide direct quantitative estimates of the degree of substitution across the three types of care. Particular attention must be given to the covariance structure of a model such as this, since regression models containing lagged variables are often extremely sensitive to any dependencies among disturbance terms. Nevertheless, the opportunity to secure direct estimates of this type should not be missed.

TABLE 8.2

QUARTERLY PART A MEDICARE REIMBURSEMENT PER ENROLLEE
Waivered and Nonwaivered States

	-------OLS Estimates--------			---Fixed-Effect Estimates---		
	Overall	Urban	Rural	Overall	Urban	Rural
Intercept	188.248	240.680	206.967			
	(31.4)	(21.8)	(38.5)			
URBAN	19.0707					
	(9.9)					
SPRING	-10.5279	-10.7227	-10.0649	-10.5279	-10.7227	-10.0649
	(-6.5)	(-4.3)	(-6.5)	(-13.5)	(-9.5)	(-10.0)
SUMMER	-11.4519	-11.1955	-12.0617	-11.4519	-11.1955	-12.0617
	(-7.1)	(-4.5)	(-7.7)	(-14.7)	(-9.9)	(-11.9)
AUTUMN	0.5982	2.2712	-3.3729	0.5982	2.2712	-3.3729
	(0.3)	(0.9)	(-2.0)	(0.7)	(1.9)	(-3.3)
REGION2	-1.0857	-12.9488	4.7694			
	(-0.4)	(-3.2)	(2.0)			
REGION3	-0.5716	-15.9065	4.8767			
	(-0.2)	(-3.7)	(2.4)			
REGION4	-27.6336	-51.8243	-16.0175			
	(-10.1)	(-9.5)	(-7.9)			
REGIONS5	-25.8588	-35.4318	-13.7396			
	(-10.9)	(-9.7)	(-5.3)			
AUT86DUM	-56.8898	-65.4578	-36.3721	-56.8898	-65.4578	-36.3721
	(-16.4)	(-12.2)	(-10.8)	(-33.9)	(-27.1)	(-16.7)
DYR82	69.2104	78.8131	40.5228	54.9958	53.6263	36.3385
	(11.4)	(7.6)	(4.4)	(21.8)	(14.7)	(6.3)
DYR83	35.4894	36.2796	27.2826	37.8516	37.4608	30.8844
	(7.1)	(5.4)	(3.1)	(15.5)	(11.5)	(5.4)
DYR84	-15.7612	-12.0792	0.0195	-25.6601	-11.4736	-2.5227
	(-2.3)	(-1.1)	(0.0)	(-7.8)	(-2.2)	(-0.4)
DYR85	-10.0048	-13.7703	-9.8849	1.4664	4.6880	0.1582
	(-1.3)	(-1.2)	(-1.0)	(5.9)	(0.9)	(0.0)
DYR86	33.4391	34.3961	28.3314	21.8074	20.7153	22.0789
	(4.6)	(3.5)	(1.5)	(5.9)	(4.5)	(1.6)
BENPOP	-1.8561	-2.8932	-2.6694	-7.1582	-4.8437	-13.5801
	(-7.6)	(-7.5)	(-10.4)	(-5.0)	(-2.2)	(-7.9)
HBEDPOP	4297.0	4575.8	3709.9	21,901.4	28,024.8	13,405.0
	(5.7)	(3.6)	(5.6)	(8.3)	(6.5)	(4.8)
HBEDPOP#	-495.8	510.2	-1736.2	-1930.2	-2036.5	-3015.4
	(-0.4)	(0.3)	(-1.8)	(-3.5)	(-2.3)	(-4.6)
PHYSPOP	19,102.3	19,671.3	2214.4	25,473.3	52,718.9	3570.3
	(10.4)	(6.6)	(0.8)	(4.3)	(3.3)	(0.7)
PHYSPOP#	8618.7	7132.8	-6252.1	14,221.4	8613.4	-1061.3
	(4.3)	(1.9)	(-1.7)	(14.4)	(4.8)	(-0.4)

TABLE 8.2 (continued)

	OLS Estimates			Fixed-Effect Estimates		
	Overall	Urban	Rural	Overall	Urban	Rural
HMOPOP	2.4969 (16.5)	2.6362 (11.9)	2.7638 (12.9)	-0.0873 (-0.4)	-0.7397 (-2.6)	-2.2805 (-2.4)
HMOPOP#	-0.4521 (-2.4)	-0.5304 (-1.8)	0.6731 (2.4)	-0.4480 (-4.6)	-0.6109 (-4.3)	0.9659 (4.7)
NBEDPOP	210.63 (0.4)	-3637.9 (-3.1)	1501.3 (3.9)			
NBEDPOP#	-2436.7 (-4.4)	-3645.2 (-2.9)	-1192.4 (-3.0)			
WAIVER	-11.4057 (-2.8)	-8.4867 (-1.4)	-1.7777 (-0.3)			
MANY86	7.6861 (1.0)	8.1408 (0.8)	19.1435 (1.0)	25.1060 (6.3)	28.5960 (5.7)	27.2172 (1.9)
(1-WAIVER)DYR82	-1.7733 (-0.3)	-3.2130 (-0.4)	15.1185 (1.7)	-3.2147 (-1.2)	-0.3026 (-0.1)	10.2695 (1.7)
(1-WAIVER)DYR83	-11.3516 (-2.1)	-10.5764 (-1.4)	-6.0085 (-0.7)	-11.2350 (-4.3)	-9.3558 (-2.7)	-8.0804 (-1.4)
(1-WAIVER)DYR84	30.0053 (5.4)	28.0992 (3.6)	29.3284 (3.2)	35.5543 (13.1)	31.6535 (8.9)	29.6946 (5.0)
(1-WAIVER)DYR85	24.2629 (4.5)	25.0677 (3.3)	25.3940 (2.9)	24.4823 (9.4)	27.5809 (8.1)	24.0426 (4.2)
(1-WAIVER)DYR86	-26.9400 (-3.6)	-27.9221 (-2.7)	-22.0990 (-1.1)	-14.5949 (-3.9)	-14.3117 (-3.0)	-13.6076 (-1.0)
R^2	0.54	0.47	0.53	0.90	0.90	0.81
N	8376	4032	4344	8376	4032	4344

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HOSPITAL ADMISSIONS

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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--

PPS AND HOSPITAL ADMISSIONS

Working Paper

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PPS and Hospital Admissions

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1.0 INTRODUCTION

The incentives of PPS were expected to create substantial changes in the volume and composition of services covered by Medicare. These likely utilization changes are not restricted to reduced volumes of inpatient services provided by hospitals, but include offsetting changes in the volumes of outpatient, physician, home health, and nursing home services. The nature and magnitude of these utilization changes are central to the viability of PPS as a payment policy; the financial viability of hospitals under PPS depends, in large part, on their ability to manage utilization; the impact of PPS on beneficiary health largely depends on their continuing ability to access the needed mix of services in a coordinated and timely way; and the viability of PPS to HCFA depends on the reimbursement consequences of the changes in mix of covered services.

Making more effective use of hospital services depends on how the admission and discharge "gates" of the hospital are managed. Elimination of unnecessary ancillary service use also depends on effective control devices. Equally important, many of the threats of unintended adverse effects of PPS can occur if utilization management is not performed in a responsible fashion. Potential for access problems arising due to "skimming" profitable cases and "dumping" or transferring costly cases is also a direct result of strategic utilization management. Premature discharge and inadequate ancillary service use may also be the consequence of PPS incentives and overzealous utilization control; Profession Review Organizations (PROs) were established in tandem with DRG payments to limit these problems. Finally, the threat that beneficiaries will be subjected to higher risks of discontinuities or gaps in their use of services across providers is also a utilization management concern.

The question posed in this paper is the extent to which the elevated concern of utilization management in hospitals has influenced the choices physicians make in deciding to admit patients. We examine hospital admission rates under PPS, looking at the influences on admission rates relating to PPS, PROs, and market characteristics. We also examine the issue of allocation of admissions across hospitals, to see if there is evidence of selective admission policies in hospitals.

The paper is organized into five sections. First we report case study findings on how hospitals have responded to PPS in terms of controls on physician behavior and patient management practices. Second, we offer a theoretical model of PPS as it affects physician and hospital behavior relating to patient management. A third section presents descriptive statistical evidence on admission rates, and influences on those rates. A fourth section presents econometric evidence of PPS effects on admission policies. And, a fifth section discusses econometric findings on market and PRO influences on admission rates.

2.0 What Have Hospitals Actually Done to Respond to PPS?

Extensive case studies conducted for HCFA[1] in 10 sites and 100 or so hospitals have documented the types of actions hospitals have taken in response to PPS. Administrators, utilization and discharge coordinators, and admitting physicians were interviewed in each hospital. In general, results indicate that hospitals are investing considerable energy in cost control and revenue diversification strategies, and are being much less aggressive in controlling physician practice. The case studies suggest that hospitals are behaving as if the marginal cost of additional admissions and days are extremely low, due to excess capacity, and that the attendant incentives to maximize admissions are dominating theoretical PPS incentives to specialize in "profitable" cases and to deal aggressively with unprofitable physicians. The general PPS strategy hospitals appear to be following in their relations with physicians is composed of:

- Make every effort to recruit and retain admitting MDs;
- Eliminate extreme utilization abuses in length of stay and social admissions;
- Recruit specialist MDs and invest in technologies to fill gaps in scope of services and patient referral patterns;
- Make some additional investment in better discharge planning to make it easier for MDs to discharge patients earlier;
- Identify and solve big "loser" DRG problems; and
- Heavily rely on peer pressures to control length of stay rather than using invasive controls.

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[1] Case studies were conducted by Abt Associates and Health Economics Research in the fall of 1986.

Controls on Physicians. Hospitals have used educational and administrative tools to reduce the intensity of hospital services. Most hospitals have held meetings with medical staff. The early meetings appear to have had a common theme--"What has to happen to length of stay in order for the hospital to survive under PPS". These sessions seemed to have created a sense of nervous anticipation about PPS among admitting staff that led directly to a good portion of the massive length of stay reductions across PPS hospitals. Very few hospitals have continued such "doom and gloom" meetings with staff.

Admitting practices have changed markedly as virtually all hospitals have imposed a (retrospective) nurse review of all Medicare admissions. This review activity is solely motivated by the implementation of the PRO program to which physicians and staff alike attribute the decline in admission rates. In reviewing the admitted cases, hospitals attempt to mimic PRO criteria as exactly as possible. Hospitals have not attempted to eliminate all unnecessary (unreimbursable) admissions. Most physicians we interviewed suggested that on some occasions "social admissions" were permitted as a concession to the physician and family.

Most hospitals adopted and continue a practice of preparing a face sheet for patient charts, which shows the working DRG, the average length of stay (as published by HCFA), and the outlier thresholds. This ever-present document provides some reinforcement to physicians about the hospital's concern with stay length. All hospitals also have a nurse(s) that reviews the stay length of all Medicare cases, often daily, but more commonly several times a week. This review is usually coupled with a revolving panel of admitting MDs to whom the nurses refer instances where documentation fails to support the need for continued hospitalization. Very seldom do "disputes" seem to arise about the admitting physician's judgment, and it is extremely rare to find instances where physicians are sanctioned or disciplined for abusing utilization privileges. It is not so uncommon for MDs to lose admitting privileges if documentation on discharged patients is not thorough and prompt. It is not possible to observe the effectiveness of this concurrent utilization review process. Physicians do not generally regard the process as invasive, but do believe that it tends to reinforce growing peer recognition of efficiency in treatment as one dimension of exemplary medical practice.

Most hospitals implemented systems for reporting the "revenue" and "cost" for various DRGs, and for particular admitting MDs. Usually DRG payment rates are compared to charges or charges discounted by the ratio of charges to costs. These accounting systems have been used by hospitals to identify apparent "loser" DRGs, often

precipitating special follow-up studies. A number of interesting efficiency-promoting changes have been reported as a result of such studies. Examples include:

- Purchasing a C-ARM for use in hip surgery to cut the elapsed time of surgery and OR use.
- Development of a parenteral nutrition program to cut the stay length of open heart surgery stays.
- Educating MDs on better test sequencing and conditional test ordering for shortening stays of persons admitted with undiagnosed gastrointestinal disorders.
- Hiring a staff diabetologist to help admitting MDs be more precise and efficient in treating patients who have diabetes as a complicating diagnosis.
- Establishing a policy to pay for at-home use of expensive post-operative antibiotics (not covered by Medicare), rather than extend stays to allow the drugs to be administered in the hospital.

Many hospitals have stopped preparing such profit/loss reports on individual physicians, inasmuch as the reports were rarely used to try to monitor and control physicians. Physicians in many hospitals never routinely received copies of such reports, and the ones who did regarded them as a curiosity rather than as a useful guide to action or policy.

Probably the best indication of the vigor of hospital attempts to control physician use of hospital services is to note the types of control practices that were *rarely* observed in the case study hospitals. Among these infrequently observed tactics are:

- 100% *pre*admission review and approval of Medicare admissions.
- *Written* justifications by physicians for length of stay beyond expected or target levels.
- Vigorous MD (rather than nurse) involvement in the operation of utilization control systems.
- Monitoring or control systems for ancillary and ICU/CCU services.
- Extensive one-on-one MD education.

It is widely believed that hospitals have stopped short of the sort of invasive control systems that could have contained these features to protect relations with admitting MDs.

Specialization. There has been no evidence that hospitals are trying to specialize admissions in favor of "profitable" DRGs and away from "unprofitable" DRGs. In general, hospitals are simply not as concerned about the location of the biggest margins as they are about the location of the biggest leakages from their potential patient pool. Hospitals do not have good data on "costs" at the DRG level and, as long as occupancy rates are so low, probably have no need to specialize against any class of admissions. Hospitals are mainly concerned about purchasing technology and recruiting specialists to serve as many patients as possible. Some hospitals perceive large "leakages" of cancer treatment, heart bypass surgery, and other specialized patients. These hospitals were actively recruiting specialists and equipment, often trying to establish "centers of excellence" and were not the least concerned with DRG payment rates in their decisions. Analysis of DRG win/lose is not being done to support selective specialization.

Rural hospitals have the biggest problem stemming leakages of specialized care and maintaining their viability as "real" hospitals. Many are actively purchasing special equipment and recruiting part-time specialists from adjacent urban areas to bolster their service mix. Many of these hospitals are apparently losing money on these product development strategies, but can sometimes afford the loss due to higher than usual Medicare payments overall. Most feel that providing specialized orthopedic, cardiology, urology, and opthamology services is essential to survival--and some are willing to incur exorbitant round-trip ambulance charges to send patients to cities for special tests, rather than risk the community image consequences of discharging the patient to the urban hospital.

The case studies did yield evidence that traditional "dumping ground" hospitals were taking steps to limit that source of patients. Hospitals were observed to impose "medical necessity" screens on referrals from other hospitals. It is not clear that this practice reflects higher volumes of dumping, or just increased sensitivity to bad debt expenses.

Discharge Planning. Hospitals are observed to be investing more energy into discharge planning to help physicians expedite earlier discharges. Discharge planning in most hospitals is moving from a social work function of simply arranging for placement toward more of a nursing function, which is integrated with the utilization review process and encompasses assessment, monitoring, placement, and tracking functions. While this trend is important and discernible, it is clear that discharge planning is not yet perceived by hospitals (or physicians) as an important, proactive, case management tool for patient flow management.

Many hospitals now establish explicit criteria for active and automatic participation of the discharge planner from the point of admission, recognizing the likelihood that the patient will be needing special services or institutional placement at the point of discharge. Most hospitals, however, require the physician to "order" the participation of the discharge planning unit. Hence, there are frequent reports of continuity problems associated with an unexpected decision of the physician to discharge such a patient without prior arrangements for necessary post-hospital care services.

3.0 Theoretical Model

Most of the established models of utilization provide little guidance on the likely PPS effects on utilization across covered services within a spell of illness. Essentially all these models are designed to analyze either a single actor, usually the doctor or hospital administrator, or a single setting, typically the hospital. (See Benson and Mitchell (1986) for an excellent review.) The exception is some recent work by Pauly (1982), Custer (1986), Custer and Musacchio (1986), and Benson and Mitchell (1986). These papers are admirable since they represent the first attempts to formally model the interactions between physicians and hospitals. The Pauly (1982) article, which for some reason has not been widely cited, studies the relation between physician practices and hospital inputs but does not explicitly model the hospital itself or its response to physician preferences. The work by Custer, and by Custer and Musacchio, focuses on affiliation and uses hedonic pricing theory to develop a model which describes both the patient's selection of a physician and the physician/hospital affiliation agreement. The Benson and Mitchell model also has two optimizing agents. Their model posits a hospital decision making process where the hospital administrator chooses hospital capacity and sets a breakeven price for hospital services while a cartel of doctors sets the level of use of the hospital by directing their patients to the hospital.

The model presented here is similar to these models but focuses on the relation between the hospital reimbursement policies associated with Medicare and the practice patterns and preferences of admitting physicians. It is unique in centering on the episode of care by emphasizing that doctors can work in several different settings and the setting in which treatment will occur and the way in which care is delivered will depend on reimbursement regulation. PPS (and the PRO program) enters the decision process by providing hospitals with strong incentives to exert controls on physicians' command of hospital services which are viewed by physicians as "prices"; this schedule of "prices" or "hassle

factors" influences the choices physicians make about the setting and intensity of care. Using this model, a number of hypotheses regarding the impact of PPS can be developed.

The model establishes the conditions under which length of stay will fall and various substitutions of non-hospital and inpatient care will occur. The model is particularly interesting because it is also capable of explaining why, in the short run, the introduction of a PPS system might cause the number of hospital admissions to fall. Indeed, a decade of admissions growth has been reversed in the first two PPS years. Interestingly, one of the unintended effects of PPS that many analysts most feared was a larger overall rise in admissions as hospitals tried to capitalize on the opportunity to profit from encouraging more admissions, particularly less severe cases (Gutterman and Dobson (1986), ProPAC (1986) Ellis and McGuire (1986)). Studies of an earlier similar program in New Jersey have found this effect (Coelen et al., (1986), Rosko and Broyles (1986)). The model suggests that in a regime where hospitals resort to traditional instruments for controlling physician service use, admission rates are likely to fall and average severity will rise; over time, however, hospitals have strong incentives to develop new instruments for control, which might permit admission rates of less severe cases to rise.

Physician Behavior

The model developed below begins with Feldstein's (1974) notion that the physician acts as an agent for a patient. In particular, the patient is assumed to contract with a physician to deliver some expected level of health services by allowing that physician to choose the levels and mix of health services.[2] For simplicity, the physicians are assumed to ignore any costs of treatment which are borne by the patient. The assumption will hold for all the Medicare patients which have purchased additional insurance so that they are completely insured. Hence, the role of the patient is summarized by his implicit arrangement with the doctor. Their contractual relationship for a particular episode of illness will be characterized as:

$$E[F(X_1, X_2, X_3, X_4, H)] = \bar{H} \tag{1}$$

where

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[2] The method by which the patient selects a particular doctor is not modeled, but one of the determinants of this process will involve the consonance of the patient's and physician's attitudes toward alternative techniques for treatment. The Custer model (1986) presents an approach for endogenizing the determination of this relationship; however, for the purposes of this paper, the associated complications within the Custer approach outweigh the benefits.

F = the health production function faced by the physician, which may depend on the severity of the patient's condition (H),

$\bar{H}$ = the level of wellness demanded or expected by the patient or customary standard for local medical practice,[3]

X_1 to X_4 = a collection of inputs used by the doctor in delivering care (inpatient care, office visits, etc.),

H = presenting health state or severity of the patient, and

E = the mathematical expectations operator, which is included to capture the uncertainty associated with medical diagnosis and treatment.

This formulation of the contract implies that the physician is obliged to use a combination of inputs which, on average, will produce the desired outcome. The relation is assumed to hold for a given episode for a particular patient, although a doctor will have a number of patients and each patient may have a different presenting ailment. The doctor's production function F is a vector function which produces health in each of a number of presenting categories. For each presenting condition, F can potentially take a different functional form and the production function might depend on the severity of the patient (H).[4] For instance, the methods for treating severe and mild pneumonia cases might be very different.

The inputs that are available to the doctor are of four types: inpatient hospital services (X_1), outpatient hospital services (X_2), aftercare or post-discharge services (X_3), and his own offices and resources (X_4).[5] The doctor's choice between these inputs will in general depend on technical, professional and economic factors. The technical and professional aspects of the physician's decision about using different inputs will be guided

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[3] For the purposes of this discussion, determination of the level of wellness is ignored -- undoubtedly a number of important policy questions will thus be overlooked. Again, patients might select doctors on the basis of the doctor's abilities to efficiently produce different levels of $\bar{H}$. This issue can be more easily addressed in the Custer framework.

[4] Similarly, $\bar{H}$ will be a vector which may be non-zero only in the category corresponding to the patient's illness, and the inputs X_1 to X_4 can be thought of as vectors of inputs with different levels available for different presenting conditions.

[5] The better known Pauly model (1980), uses a similar characterization of the doctor's tools, distinguishing between ambulatory services and hospital services. The development here seeks to focus attention on a more detailed set of physician options which involves several substitutable settings.

by expertise, preferences regarding various substitutes, and the prevailing technology and local norms of practice.

The influence of technology and area norms regarding treatment deserve further attention. Certain presenting conditions mandate certain decisions by the physician about the setting of care. For instance, if a patient complains of chest pain and is diagnosed to have a changing EKG, any competent physician will admit the patient to the hospital. In other cases all physicians might agree the patient should not be hospitalized. In many cases there is no consensus on what is needed. The studies of small area variations in medical care illustrate the opportunity of discretion.

In this model, these customs as well as technological constraints are explicitly considered, by positing a required or conventional minimum level of inpatient care for each patient, denoted as $\overline{X}_{1n}$.[6] Upon the initial contact (office, telephone), the physician is assumed to determine the severity, complexity, and level of certainty of a patient's presenting complaint. This process can be imagined as ranking the patient's "severity" relative to some representative distribution of patients presenting in this way -- for each diagnosis or presenting condition this distribution will be very different. Having established the "severity" of a case, the physician determines whether conventions dictate that particular combinations of inputs are required. For the patient with the cardiac problem in the preceding example, the presenting situation placed the patient at a level of severity and risk such that hospitalization was required. For simplicity it is assumed that for each diagnosis or presenting condition there exists such a threshold level, above which hospitalization is typically required.[7] This threshold may exist because of technological restrictions -- the required equipment only exists in the hospital -- or because of area or physician customs.

The exact relationship between the degree of severity and the required level (intensity) of inpatient services will be left unspecified. However, it will be assumed that there is a monotonic relationship so that in general the relation between the two. For instance, one patient might have a mild viral infection. The facilities available at a hospital would be useful in treating the patient but treatment might also be competently administered on an outpatient basis. Another patient may be more "severe" and will

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[6] The notion of required levels of care has been used by Feldman et al. (1981).

[7] This assumption can easily be relaxed so that there is uncertainty regarding the mapping between a diagnosis of given severity and the implied level of usage for each input.

require some inpatient treatment. This treatment might be necessary because certain technology is only available in a hospital or perhaps because malpractice considerations mandate hospitalization. For some cases hospitalization is required, while for others it is optional.[8]

The other factors governing the physician's behavior are assumed to be economic. The physician is assumed to be trying to maximize utility while treating the patient (see Pauly [1980], Pauly and Redisch [1973], Shalit [1977], and Feldman, et al. [1981]). The utility function used here takes the form of a real profit function. In particular, the doctor attempts to maximize the difference between the compensation he receives for using different inputs and the costs he must bear in order to use those inputs. Many of these costs and benefits are not monetary quantities.

The costs the physician incurs in providing treatment are easier to identify and, as will be shown below, are the key to the model since they link the behavior of the doctor and the hospital. The costs arise because the doctor pays a set of implicit prices to use each unit of input (X_1, X_2, X_3) provided by other organizations. For instance, some of the nuisances involved with using hospital services include filling out admission forms, spending time ordering tests to be performed, scheduling OR time and tolerating a certain amount of jawboning from hospital administrators and UR coordinators.[9] Each admission, each test, each day of care, each special-unit admission, and each surgical procedure in the hospital will carry with it a "price" to be borne by the physician. In using his own resources, the doctor must consider both the opportunities forgone by not treating other patients (or consuming more leisure) and the direct labor and capital costs he incurs in providing services. The more hospital resources involved in the treatment, the more administrative barriers the doctor is likely to encounter. Similarly, devoting excessive amounts of the doctor's own services to any particular patient becomes increasingly costly since leisure is increasingly scarce, the returns to patient health are likely diminishing and foregone opportunities to serve other patients in the practice are increasing. The view that the administrative burden of using facilities is an important

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[8] Even if the actual distributions of severity are quite different than the one assumed the results still obtain. For instance, even if the distribution is camel shaped the results in the text still obtain.

[9] There is survey evidence that physicians strongly dislike administrative paperwork. (See Sloan, Mitchell and Cromwell, 1978).

factor in determining resource usage is not new. Indeed, 18 years ago Evans (1971) suggested that:

> one could recognize that the demand for hospital services is generated by medical practitioners who consult the relative benefits of hospitalization to themselves and their patients with weights that presumably vary from practitioner to practitioner. Thus, when facilities are crowded, the time and trouble cost to the doctor for an admission goes up and correspondingly the rate of utilization of hospital beds goes down. (original emphasis)

Based on these observations, the physician's problem for a single patient can be stated as:

$$(2) \qquad \max_{X_1,X_2,X_3,X_4} \pi = (S_1 - P_1)X_1 + (S_2 - P_2)X_2 + (S_3 - P_3)X_3 + (S_4 - P_4)X_4$$

subject to (1)

and $X_1 \geq \bar{X}_{1n}$

where

$\bar{X}_{1n}$ = the conventional minimum required level of inpatient usage for the nth patient type

X_1 to X_4 = inputs of various settings employed by the physician,

P_1 to P_4 = "prices" of X_1 to X_4,

S_1 to S_4 = the compensation expected to be received by the physician for choosing a pattern of care which uses units of service in the various settings,

and the dependence of the Ps and Ss on the Xs is subsumed for notational convenience and it is understood that the physician will sum over patients.[10]

In solving this problem, the physician is assumed to take S_1 to S_4 and P_1 to P_4 as given although the prices and fees should be considered schedules which vary with

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[10] The issues concerning any capacity constraints facing the physician and their implications will be discussed in Section III.

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levels of inputs.[11] For the monetary portion of the physician's fees, this is a reasonable assumption since the "allowable charges" which physicians can collect are more or less known. Similarly, the prices paid by the physician to support staff and for office equipment will be determined by market conditions. Hospital, outpatient and aftercare providers will each set the schedules of prices for the use of their respective services which in the short run the physician can reasonably be expected to take as given.[12]

Given these assumptions, and the usual assumptions about the smoothness of the health production function, the physician's problem is well defined and can be solved to yield the optimal levels of the inputs, X_1 to X_4, as a function of the prices, fees and the required level of inpatient care. A formal derivation is left until the next section, where some comparative static exercises are discussed. At this point, it is useful to recall that for some patients this optimal mix of services will necessarily have to include some inpatient services. For these cases, the pricing system will determine how much more inpatient care is selected by the physician. For the patients who require no inpatient services, $\bar{X}_{1n} = 0$, the prices will determine whether any hospitalization occurs. A further discussion of the optimal levels of inputs will be deferred until the hospital portion of the model is developed.

The role of the Professional Review Organization (PRO) in the model has not been explicit. PROs essentially regulate physicians in terms of the "necessity" of admission and discharge. Through review of sample cases PROs can influence the reimbursement going to hospitals by signaling instances to the Fiscal Intermediary where payment should be denied; e.g., where the admission was not medically necessary or where the subsequent admission was simply a continuation of an earlier admission. PROs also established guidelines for some surgical procedures to promote the use of day surgery, and limit the instances where reimbursement for inpatient surgery is made.

The implementation of the PRO program (which accompanied PPS, but was generally not operational until CY 1985) should have exerted a one-time reduction in admissions by:

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[11] In this model the physician may be able to profit if can induce demand for any marginally necessary or unneeded services which he can cheaply provide. The empirical question of the importance of induced demand remains an open issue. Pauly (1980) and Rossiter and Wilensky (1983) argue that this effect is small.

[12] From a longer run perspective, such as in Custer and Musacchio (1986), physicians and hospitals or nursing homes might chose to sever their ties if either party was unhappy, and hence the physician will have some power in determining prices.

- changing the local norm for accepted admitting practice;
- by elevating the risk (to hospitals) of not getting paid for a particular admission; and
- by directly denying admission reimbursement for some Medicare cases (e.g., the admission occurred, but was not recognized nor counted as a Medicare admission).

In the model, the presence of PROs will elevate hospital "hassle factors" imposed on physicians as well as alter the local area technology or "custom" for the necessity of admission for a particular kind of case.

Hospital Behavior

The hospital, also assumed to be an optimizing entity, seeks to maximize profits (or surplus) subject to a quality constraint. The hospital's concern for quality is entered as a constraint as opposed to an argument in its utility function for several reasons. First, for purely technical reasons, which will become apparent below, this treatment is much simpler. Second, this treatment parallels the formalization of the physician's problem with regard to the patient's welfare. Third, this characterization facilitates extensions involving longer-run strategic behavior which might be undertaken by the hospital.

The important link between the hospital and the physician arises because the hospital in setting prices will influence the physician's demand for its services. Indeed, a sophisticated hospital would want to set its prices with this in mind, i.e., it would set prices so as to induce the physicians to choose to purchase the levels of inpatient and outpatient services which are optimal for the hospital. That is, if the hospital is trying to restrict volumes of laboratory testing or ICU use the pertinent policies, procedures and UR activities would be toughened, effectively increasing the "price" to the physician for using units of these services.

Medicare regulation enters the model by affecting how hospitals are reimbursed for the services they provide (X_1). Alternative reimbursement schemes will affect the revenue-generating algorithm which hospitals face, which will alter the mix and intensity of services they would prefer to deliver to any patient. With this set of preferences in mind they would revise the "prices" they set for admitting staff for using various services within the hospital, which in turn will alter the services which the physicians choose to use. The hospital must presume knowledge of physician demand schedules, and errors made by the hospital in price setting will call out too much or too little service use by

the recommending physicians. Through repeated trials of price changes, the hospital's preferred mix of services can be approximated as physicians adapt by altering admitting and practice behaviors.

Formally, this description of the hospital's goals can be expressed as maximizing profit which is the sum of outpatient and inpatient revenue less the sum of outpatient and inpatient costs.

$$\pi = V_1(X_1(P_1, P_2)) + V_2(X_2(P_1, P_2)) - (W_1L_1 + r_1K_1) - (W_2L_2 + r_2K_2)$$

subject to $X_1 = g_1(L_1,K_1)$ for inpatient care

$X_2 = g_2(L_2,K_2)$ for outpatient care

$\bar{Q} \leq Q(X_1,X_2)$

where

V_1,V_2 = the general reimbursement functions set by regulators to determine the levels of compensation to be provided to hospitals

X_1,X_2 = the levels of inpatient and outpatient services demanded by the physician. For convenience it is explicitly noted that these levels depend on P_1, P_2; however, they also depend on P_3, P_4, $\bar{X}_{1n}$ and S_1 to S_4.

P_1,P_2 = the implicit prices/barriers used by the hospital in encouraging and discouraging resource use within the hospital

L_i = the labor employed by the hospital in producing X_i

K_i = the capital employed by the hospital in producing X_i

g_i = the production technology employed by the hospital in producing X_i

w_i = wage rate for labor of type i

r_i = rental rate for capital of type i

$\bar{Q}$ = level of quality or patient outcome which the hospital is obligated to provide

Q = function which describes quality in terms of the available levels of X_1 and X_2.

Several features of this representation should be clarified and highlighted. First, V_1 and V_2 are intentionally specified as arbitrary functions of X_1 and X_2, respectively. This general specification captures the notion the regulators can set the

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reimbursement for hospitals in a variety of ways.[13] For instance, if the regulatory regime is retrospective and based on cost-plus reimbursement then inpatient revenue is

$$V_1(X_1) = (1 + M)\ (w_1L_1 + r_1K_1)$$

where M is the markup on costs paid to hospitals. Under PPS, V_1 is a constant and is paid on a per-admission basis, The constant (V_1) can be viewed as the per-case rate, or the per-case rate plus some expected outlier payment amount seen at the point of admission. Algebraically,

$$V_1(X_1) = \overline{V} \text{ if } X_1 > 0.$$

As noted above these alternative reimbursement rules make it possible to study how changes in regulation will alter the hospital's choices of P_1, P_2 which in turn influence the levels of services (X_1 to X_4) chosen by the physician.

Second, the notation used to describe the production of X_1 and X_2 distinguishes the labor and capital used in each setting. This is strictly for notational convenience and generalizing the model to account for the joint use of labor and capital in the production of both inpatient and outpatient services is straightforward.

Third, potential for specialization by hospitals is captured in the production functions g_1 and g_2. Under PPS hospitals that are particularly adept and efficient in treating certain types of patients may wish to admit as many patients of these types as possible, by setting the relevant components of P_1 to low levels.

Fourth, the quality restriction is also left as an arbitrary function of the level of services. Since profits here have been defined on a per patient basis the quality constraint also should be thought of on a per patient basis. Thus the quality restriction will hold with respect to how much service a hospital can offer to a patient. The quality constraints can thus be thought of as requiring some minimum levels of X_1 and X_2, ($\tilde{X}_1$ and $\tilde{X}_2$) that the hospital wants to be able to provide for a particular patient. Accreditation certification, licensure and malpractice requirements would be the obvious reasons for assuming that the hospital needs to be able to provide these minimum levels of service. The existence of these minimum levels of service also will affect hospital

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[13] For simplicity, in the basic model it is assumed that either all reimbursement is received from Medicare patients or that the hospital can set up independent policies for Medicare and private paying patients.

pricing decisions. Accordingly, the prices which will be set by the hospital administrator will have to be low enough so that $\tilde{X}_1$ and $\tilde{X}_2$ are likely to be demanded by physicians.

III. Hypotheses from the Basic Model

Admission Rates. The first application of the basic model involves a comparison of the number of admissions under a cost plus reimbursement regime with those under a prospective payment system. The basic result which will be shown is that switching the reimbursement scheme, from cost plus pricing to PPS, can cause admissions to fall.[14]

As mentioned in the introduction, this may appear paradoxical since the incentives in a PPS environment make the admission of any patients which have low resource requirements quite profitable. Indeed, Ellis and McGuire's (1986) model suggests that hospital decision-making would generate increased admissions of less severe cases.[15] The resolution of the paradox begins by noting that the hospital stands to lose large amounts on patients who, compared to others in a DRG require extraordinary amounts of treatment or by assuming the DRG rates are incorrect for a particular DRG or hospital.[16] Also, while the hospital would like to encourage profitable admissions under PPS, the profitability of any admission is increased if the resources used to provide it are minimized. Thus there is an incentive to set constraints. To guard

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[14] In this model admissions will occur whenever a physician chooses to use a non-zero level of inpatient services. This argument ignores the regulatory effects of PROs.

[15] The Ellis and McGuire argument presumes the existence of a pool of less severe cases that fail to be admitted in the cost-reimbursed environment but would be admitted under PPS. Unless hospital strategy explicitly incorporates direct and strong incentives to physicians to admit such cases we see no reason to believe such a form of "skimming" is possible. The conventional wisdom suggests that hospitals are extremely convenient settings in which physicians can treat patients; the very marginal cases should have already been admitted in the cost reimbursement regime. While a pool of even less severe cases certainly exists, there is certainly no obvious reason why PPS should instill more pressure for physicians to admit these cases than was already present in the pre-PPS practice of medicine.

[16] Hospitals argue that even though PPS had some adjustments for long staying patients, "outliers", these adjustments are inadequate. These outlier adjustments amount to payments of sixty percent of all costs incurred after a patient exceeds certain limits — the limits are based on average costs for patient in the same reimbursement category.

against these losses the hospital will need to set its prices to physicians high enough to discourage the use of resource intensive procedures whenever possible.

Recall that in this model the use of some inpatient care will be required for the most severely ill patients. In these cases the effect of higher prices will be to drive resource use to levels that are close to minimum required levels. For these patients overall intensity can be reduced but the relevant margin of substitution will never involve completely eliminating hospitalization. Notice that without insisting that some patients require hospitalization the PPS incentives would imply that severely sick patients are the patients which hospitals would want to avoid admitting. Furthermore, even if an individual hospital is sophisticated enough to avoid admitting these costly patients, they will likely be admitted to a hospital somewhere. Hence, this type of dumping can not be responsible for the aggregate drop in admissions.

Next consider what would happen if a hospital does in fact raise prices in response to PRO constraints on payment or to minimize resource use. An unintended effect of any price increase on service use will be to induce physicians to admit fewer of the patients for whom inpatient services are optional. For these marginal patients the health benefits of hospitalization are the same as before PPS but the "costs" of the treatment borne by physicians will have risen. Hence, it will no longer be optimal for the physicians, who control the admission decision, to admit as many patients.

Thus, our model suggests that hospitals, by increasing prices to physicians, encourage a fall in admissions for those patients they would least like to lose. This seemingly irrational act stems from the assumption that the hospital does not have enough instruments at its disposal to simultaneously encourage admissions and discourage resource usage after admission.[17] In other words, this model assumes hospitals can't (or won't) act like discriminating monopolists, raising prices to physicians selectively according to the relative demand elasticity of admissions which is high (for less severe patients) and low (for more severe patients). A necessary condition is that the expected profits foregone by hospitals from discouraging admission are lower than those gained by controlling the resources utilized to treat those patients who are admitted.

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[17] Ellis and McGuire (1986), p. 145, make this point but do not point out that this tension could lead to a fall in the number of admissions.

This intuitive argument can be formalized using the model. Analytically it is simplest to solve the model beginning with the hospital's problem. The hospital's problem can be compactly rewritten as

$$\max_{X_1, X_2} \quad V_1(X_1) + V_2(X_2) - C_1(X_1) - C_2(X_2)$$

subject to $Q(X_1, X_2) \geq \overline{Q}$

This representation, where $C_i(X_i)$ is the cost of producing X_i, makes it clear that the hospital in fact cares about profits which are driven by the levels of X_1 and X_2. In general, the optimal levels of X_1 and X_2 will be determined by the usual conditions that marginal revenue equals marginal cost,

$$(5) \qquad V'(X_i) = C'(X_i)$$

so long as these optimal values satisfy the quality constraint. If the quality restriction is not satisfied, then the hospital will have to provide the minimum values of X_1 and X_2 that do produce the desired level of quality.

Now consider the implications of equation (5) under cost-plus pricing. Under cost plus reimbursement a hospital can profitably supply any amount of services. (Indeed, since the hospital is always compensated for its costs, it may not even have any incentive to produce efficiently.) Hence under this regime a hospital would want to expand capacity until it is capable of servicing any level of available demand. While it is not likely that hospitals will grow without bound,[18] they should still always be willing to take on more patients when they are below capacity (assuming that cost-based reimbursements fully reimburse all costs). Whether a case will be costly to treat is irrelevant in this regime. Hence under cost plus reimbursement hospital prices need only to be set so that discharges occur frequently enough to keep operating near capacity -- the minimum levels of service associated with the quality constraints should easily be satisfied.[19]

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[18] Of course, this result is overly simplistic because it ignores a number of market and technological conditions that would discipline such explosive growth. For instance, the organizational and administrative burden that would be associated with this hypothetical mega-hospital would be immense and would make it very difficult for the hospital to function smoothly enough to attract and maintain the required number of admitting physicians. Similarly, the threat of massive consolidation of hospital services would undoubtedly lead to regulatory intervention.

[19] Whether the hospital actually wants to operate at full capacity or somewhat below that level in order to be able to handle emergencies has long been debated (see Pauly and Friedman, 1982). For the purposes here this distinction is unimportant.

Consider what happens when the shift to PPS occurs. It should be obvious that once a patient is admitted any resources devoted to the patients directly reduces hospital profits. The hospital policymakers' dilemma is to try to hold down resource use for costly patients but still encourage admissions of easy-to-treat patients. Clearly, solving this problem will require using two instruments, one instrument will be needed to bring in patients and a second will be needed to ration resource usage among the patients who are admitted. Furthermore, the hospital policymakers need to know which types of cases to encourage admissions and which kinds to discourage. Previously this information was never needed and only one instrument was needed; all patients used to be profitable to treat and one type of instrument to attract admissions was sufficient to keep the hospital operating near capacity.

Faced with these circumstances the hospital will likely begin trying to determine how it can effectively "skim" and "dump" cases. Solving this problem will first require successfully identifying the appropriate cases to act on. Notice that a hospital will need to gather this same kind of information to find out where its comparative advantage lies. Since specialization is one of the goals encouraged by PPS, hospitals can begin collecting the needed information, but, in the short run, they can not be expected to set up any new screens without this information.

In the meantime, hospital policymakers must decide whether to adjust their policies to change their prices. Given that $V_1'(X_1)$ is nonzero before implementation of PPS and is zero after implementation, hospitals will generally wish to adjust prices facing physicians. If they had full information about demand conditions, their optimal level of prices would be set to call forth a level of demand for inpatient services that would be sufficient to just satisfy the quality constraints.

Given this scenario, hospitals may begin raising their prices to physicians. In this case, the model developed here would predict that Medicare admissions would fall. This prediction is a result of the episodic nature of the model. The physician is assumed to manage the patient throughout the entire illness and to prescribe services across several settings. If the relative "price" for using one of the settings rises then physicians will shift some of the care to other settings. Accordingly, some of the patients for whom hospitalization is optional will no longer be admitted.

The justification for falling admissions in this model actually depends on several additional conditions being satisfied. First, if a representative hospital prior to PPS was already swamped with excess demand for their services then raising prices might not change the number of patients which physicians actually admit. Of course, if a hospital

under cost plus reimbursement faced this situation it seems likely that it would expand subject to capacity regulation like CON. In any event, given the empirical evidence on occupancy rates in the last few years, this does not seem like an important problem for most hospitals.

Conceivably if faced with excess demand some physicians might agree to handle only those patients who need hospitalization because these cases might be more profitable or prestigious. In this case, despite a rise in P_1 the physician would still admit all his patients. Since the model is set up in terms of an episode for an individual patient there is no guarantee that the physician can treat all the patients who seek his services. If physician is able to expand his practice by employing additional assistants and capital this problem disappears. If the physician is unable to extend himself, then he will have to find a method for screening the patients he will treat. Obviously this case can not prevail for most physicians.

Finally, this explanation for the admissions decline is completely a short-run story. Presumably hospitals will learn or develop some way to effectively skim and specialize. Nonetheless, in the initial phase of the PPS program it is difficult to believe that hospitals could collect and process the required information and then restructure and implement a set of policies that could be used to exploit a PPS type reimbursement scheme.

Whether this explanation of the drop in admissions is reasonable should ultimately be determined through empirical work. Unfortunately the data needed to directly test the model's prediction are unavailable. At this point there is simply no satisfactory way of measuring the severity of patients as they enter the hospital. Hence, it is impossible to directly test the model's strongest implication -- that marginally severe cases are admitted less frequently and thus the average severity among patients being treated in the hospital rose.[20] However, there is some less direct evidence which supports this explanation. First, there are certainly anecdotes suggesting that hospital administrators have made blanket pronouncements to staff physicians that length of stay must be reduced, i.e., P_1 was increased. Also a limited amount of survey information regarding physician impressions of the impact of PPS is available. Rosenbach and Cromwell (1985) report survey evidence indicating that approximately eighty percent of physicians feel that since the introduction of PPS other physicians in their hospital have

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[20] Work by Noether (1988) using a small sample of hospitals and several tracer cases demonstrated that Medisgrpts severity scores at admission have risen.

been encouraged to discharge patients sooner. Of course this evidence is somewhat unreliable, but at least it supports rather than contradicts the assumption that P_1 has risen.

A second piece of evidence to be considered in testing this hypothesis is the change in the Medicare casemix index. Trends indicates that the cases being treated since PPS began are much more severe, and thus more expensive to treat. However, a recent study by Carter and Ginsburg (1985) attempts to decompose the drift in this index into the portion due to changes in coding/billing procedures by hospitals and the portion due to medical practice changes. They find that while most of the index's increase is due to coding practice changes there is a significant portion of the change (25% of the increase) that is real.

The third piece of evidence in favor of the model is by far the strongest. If the average severity of Medicare patients who are hospitalized has risen, then mortality rates for discharged patients should be expected to increase. In fact during the first full year which all hospitals were covered by PPS, federal fiscal year 1984, this has occurred. The fact that overall Medicare mortality has continued to fall with no apparent break suggests that there has been an increase in the average severity of admissions.

Intensity and Substitution. The basic predictions of the model relate to intensity and length of stay, and substitution against inpatient care. The physician behavior portions of the model directly suggest that as hospitals attempt to control intensity by increasing prices, physicians will substitute relatively fewer hospital inputs (X_1) and relatively more non-hospital inputs (X_2, X_3, X_4) in producing the same level of patient outcome.

The substitutions are forced because of the change in relative prices facing the physician $(\frac{P_2}{P_1}, \frac{P_3}{P_1}, \frac{P_4}{P_1})$ which will make inpatient hospital services appear more expensive and because the target level of health ($\bar{H}_n$) is fixed. To the extent that the physician acts in ways that underachieve $\bar{H}_n$ under PPS, then reductions in inpatient services will not necessarily be accompanied by offsetting increases in services in other settings.

The model, as written, does not explicitly consider the opportunities for substituting between various hospital services. For instance, will we expect an increase in the use of specialized services relative to routine services? However, the hospital can be expected to make pricing decisions such that not all services are equally discouraged, which will encourage physicians to pursue less expensive (to them) substitutes when

practical and safety considerations allow. The hospital strategic response to PPS in terms of utilization control may be one of three basic types: (1) indiscriminate increase in the "price" for all types of services; (2) increase in "prices" for selected services (or changes in the relative prices of the various services); and (3) changes in the "prices" so that the absolute prices of certain types of cases are increased and admissions are discouraged.

The first policy would not alter relative prices of services for a particular case type and would not generate substitution within the hospital, but would tend to elevate prices faced by physicians for all types of cases by an amount proportional to their total intensity of service use. That is, no internal substitution (per case type) would be observed but very weak specialization against high intensity cases would be encouraged. The second strategy would clearly lead to substitutions (where possible) within the hospital and much stronger relative impacts on prices across case types; there would be strong specialization incentives against admission policies that results in heavy use of the services with prices that have gone up the most.

How would the hospital choose which services to mark up? Unless some specialization strategy was explicit (strategy 3), the choice would seem to be based on ability to administer more harassment on the particular service,[21] or simply the level of outlays per unit of the service prescribed by the physician (control of ICU admissions is likely to have more consequence than controlling admitting physician directions for dispensed drugs). The third strategy is, of course, an explicit specialization strategy.[22] Here, prices for services heavily used by some types of admissions are marked up the most. This strategy would also cause substitution of services within the hospital for many types of cases.

Hospital Market Conditions. The model supports a number of other predictions concerning the effect of the switch to PPS on physician and hospital practice patterns.

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[21] OR scheduling and ICU admission are easy to isolate and control. Intensity of nursing intervention, prescription test ordering and frequency of staff consults may not be as easy to control.

[22] It would certainly be more direct to simply prohibit admission. But anecdotal information suggests that administrators are less than anxious to make such decisions explicit. For instance, if administrators perceive that ophthalmologic surgery is a losing proposition for the hospital, they seem to prefer (at least initially) to pursue the indirect policy of severely rationing time for suitable OR facilities for such surgeons instead of explicitly telling the surgeon to take his business elsewhere.

Two kinds of hypotheses can be developed: one based on the relationship between PPS rates and the hospital's cost structure; the other dealing with market conditions facing the hospital and physicians.

The motivation for an individual hospital to react to the change to PPS by increasing prices will depend upon the proportion of its revenue which accrues from Medicare patients. The model is set up assuming that either all revenue is obtained through prospective payment or a separate set of policies and prices can be established for Medicare patients. Suppose, for convenience, that the latter assumption is true. If a hospital has only a small portion of its revenue accruing from Medicare, then even though it could readjust its policies it may not be worth the trouble of doing so. In this case, the loss of goodwill from the physicians by changing policies and making them readjust their practice patterns may outweigh the cost savings.

Likewise, the motivation for the hospitals to change policies after PPS will depend on the generosity of the fixed-fees which are offered as reimbursement. The prospective payments made for treating a patient will eventually be determined by the average costs reported by all hospitals for treating similarly diagnosed patients -- during the first three years of the program the fees depend both on national average cost and the hospital's own costs from the previous year. If a hospital is particularly efficient then being reimbursed on the basis of national average costs will not be threatening. Since these types of hospitals will be receiving more than adequate compensation, they have much less incentive to change any prices than a relatively inefficient hospital which faces the prospect of losing money unless physician controls are exercised.

These two notions, relative size of Medicare revenue and relative generosity of the fixed fees (relative to the hospital's cost history) together measure the **ex ante** "bite" of the regulation. The hypotheses just stated can be recast to say that for hospitals for which the regulation is most stringent, either because a large amount of revenue is affected or the potential losses per case appear to be high, the impact of PPS on the various substitutions and specializations will be largest.

A second set of hypotheses regarding changes in length of stay, ancillary usage and admissions can be framed in terms of market conditions. Specifically, the leverage which hospitals have over physicians will depend on how hard the hospital has to compete to attract and retain physicians. The basic model assumes that physicians are bound to a hospital. If the hospital raises the prices for its services and a physician ends up treating a patient with very high inpatient service needs ($\bar{X}_i s$ is large) the model predicts that the physician has no choice but to suffer along and bear all the nuisances embodied in

hospital policy. Obviously if a physician has some choice about where to admit the patient, the hospital will be less inclined to sharply increase prices to physicians. Hence in market areas where hospitals are forced to actively compete to attract physicians, the effects of PPS should be attenuated. This situation should prevail where there are a number of adjacent hospitals or where there are very few physicians.

Descriptive Analysis of Trends in Admissions

Hospital admissions in the Medicare program have been subject to a substantial decline since 1983. As shown in figure (1), areas of the U.S. covered by PPS and the four waiver states exhibit the same general decline in numbers of admissions per enrollee per quarter. The places covered by PPS clearly have higher admission rates than the waiver states, and those admission rates have apparently fallen faster, creating a convergence in rates between the two regions after 1984.

There have been some redistributions in admissions across types of hospitals. Figure 2 shows that admissions to rural hospitals have been reduced by half between 1981 and 1986. Urban hospital admissions have fallen, but not so markedly. Figure 3 describes trends by bedsize category. Here, there is more pronounced decline in admissions for small (1-99 beds) hospitals, and a less pronounced decline for the largest hospitals (500+ beds). These data suggest that there may have been a differential response of hospitals to the general decline in propensity to admit. Small hospitals and rural hospitals have suffered a greater relative decline; urban and teaching hospitals have been most insulated from the general decline in admission rates.

Evidence on admission rate trends for specific diseases suggests that changes in treatment technology dominate the trends, with little suggestion of PPS influences. Figure 4 shows discharge rates for 10 reasons for admission within four tracer groups: hernia, stroke, hip replacement, and pneumonia.

Trends for hernia and stroke generally mimic the aggregate national trends; while hip replacement and pneumonia show strong patterns of increasing admission rates after 1982. The second figure (Figure 5) shows tracer admission rates for waiver and PPS states, as well as urban (SMSA) and rural regions. Generally, urban and nonwaiver admission rates are higher, and trend patterns are roughly identical within tracer category. There are two notable exceptions. For pneumonia rural places have a much higher admission rate than urban areas. More importantly, the trends for hernia are less uniform. Urban and rural inpatient surgical rates for hernia are converging, as urban rates fall faster due to less surgery or a bigger shift to outpatient/day procedures. Prior

Figure 1

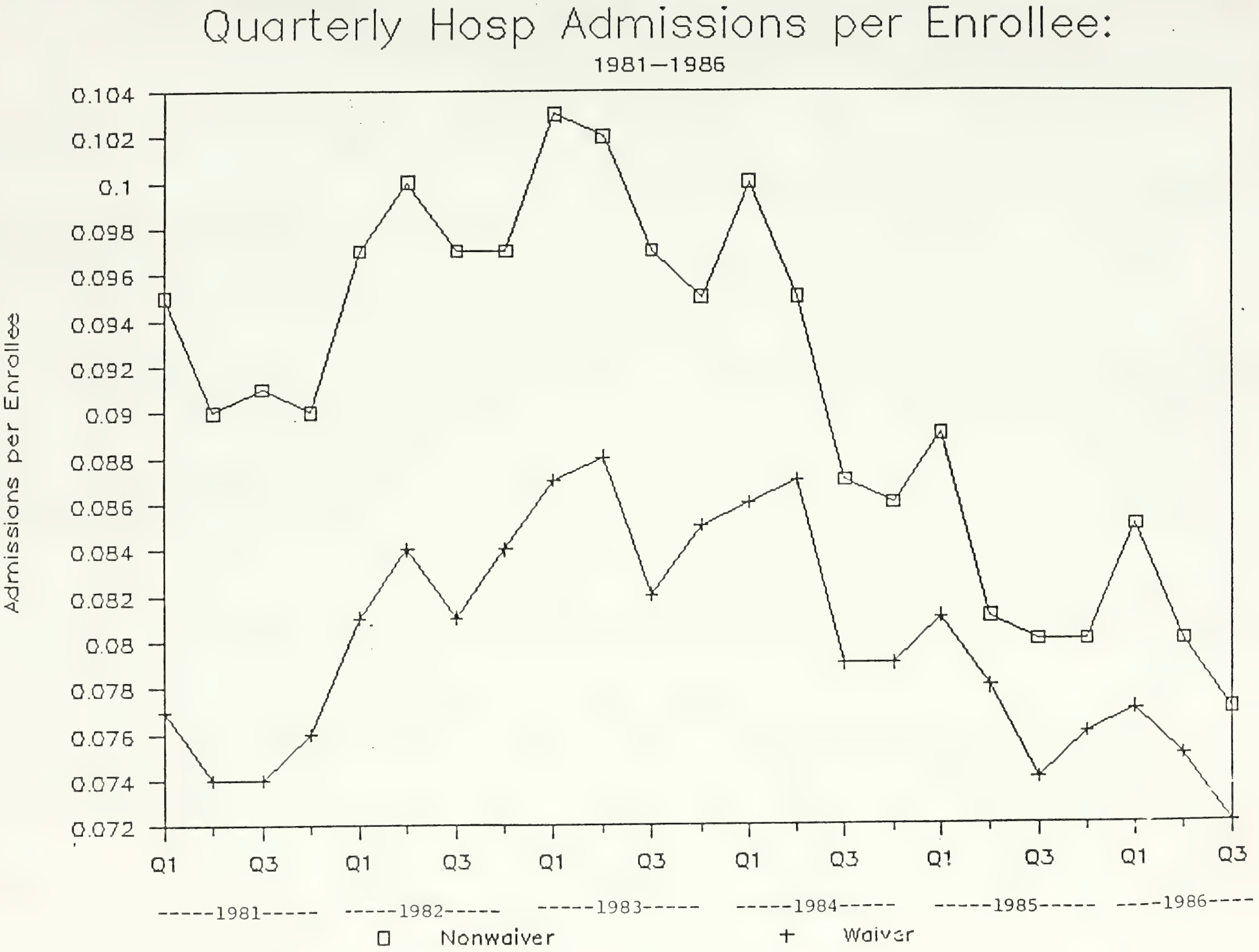

Quarterly Hosp Admissions per Enrollee:
1981–1986
Admissions per Enrollee
0.104
0.102
0.1
0.098
0.096
0.094
0.092
0.09
0.088
0.086
0.084
0.082
0.08
0.078
0.076
0.074
0.072
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
Q1
Q3
-----1981-----
-----1982-----
-----1983-----
-----1984-----
-----1985-----
----1986----
Nonwaiver
Waiver

Figure 2

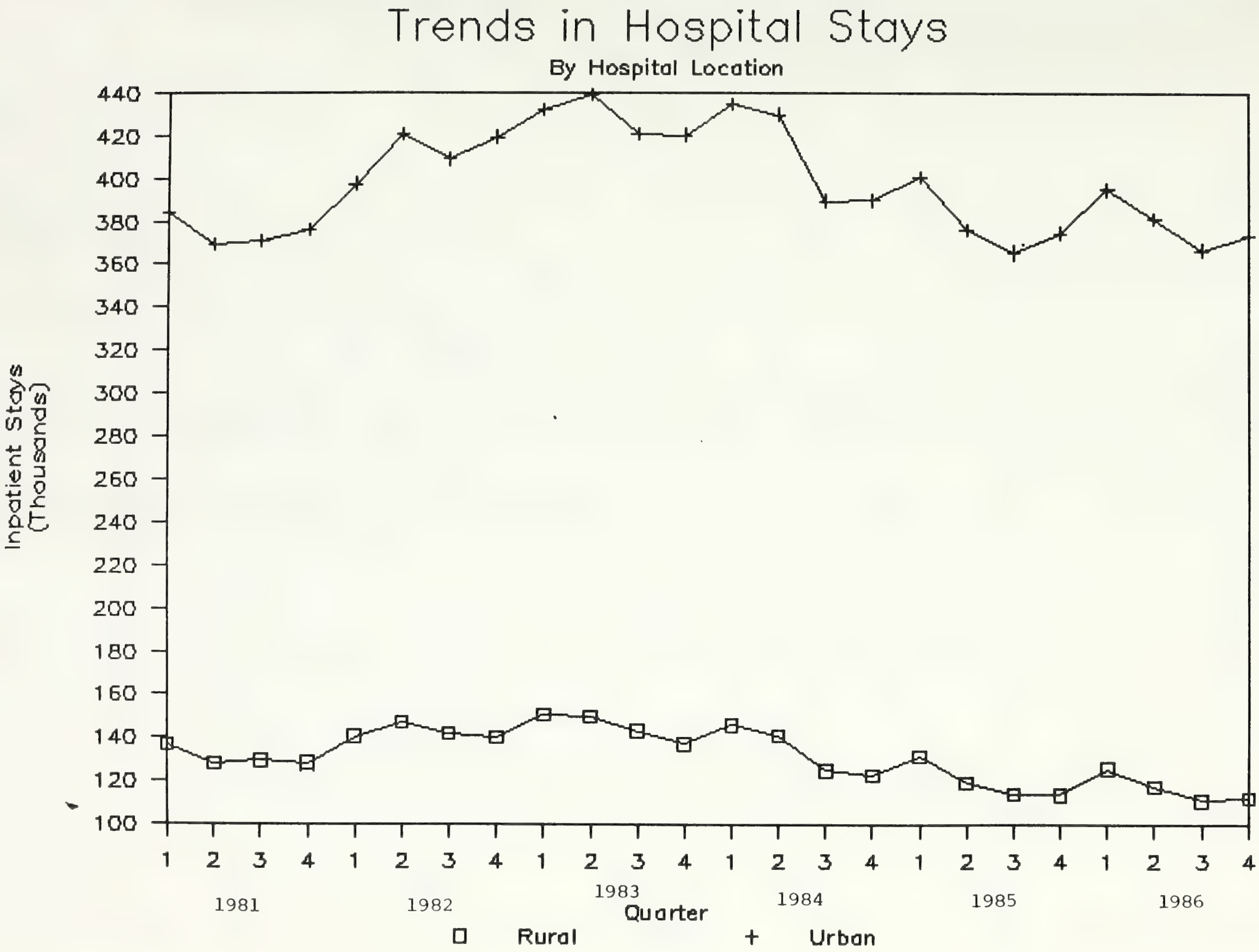

Trends in Hospital Stays
By Hospital Location
Inpatient Stays (Thousands)
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1981
1982
1983
1984
1985
1986
Quarter
□ Rural
+ Urban

Figure 3

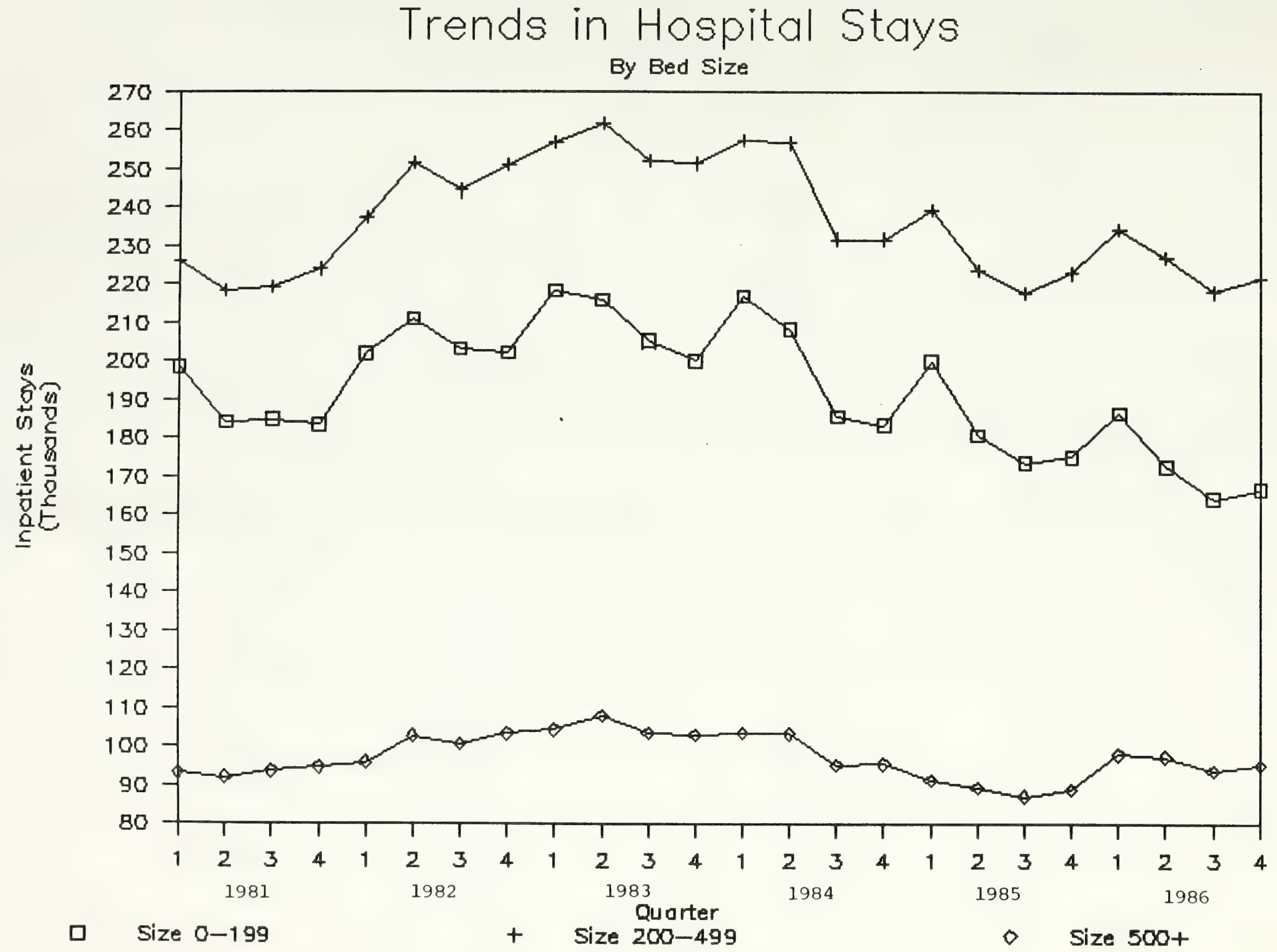

Trends in Hospital Stays
By Bed Size
Inpatient Stays (Thousands)
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1981
1982
1983
1984
1985
1986
Quarter
□ Size 0–199
+ Size 200–499
◇ Size 500+

Figure 4

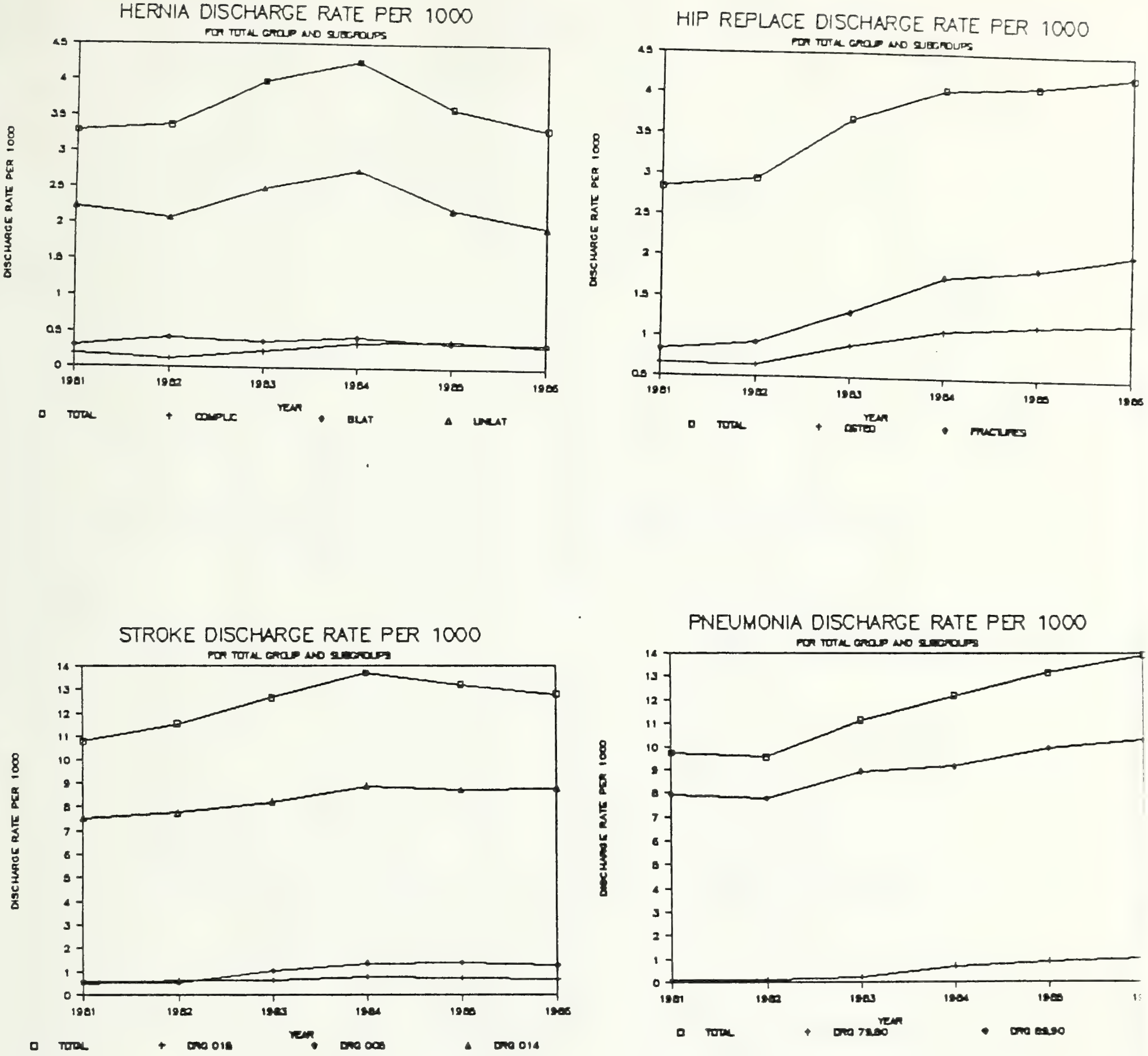
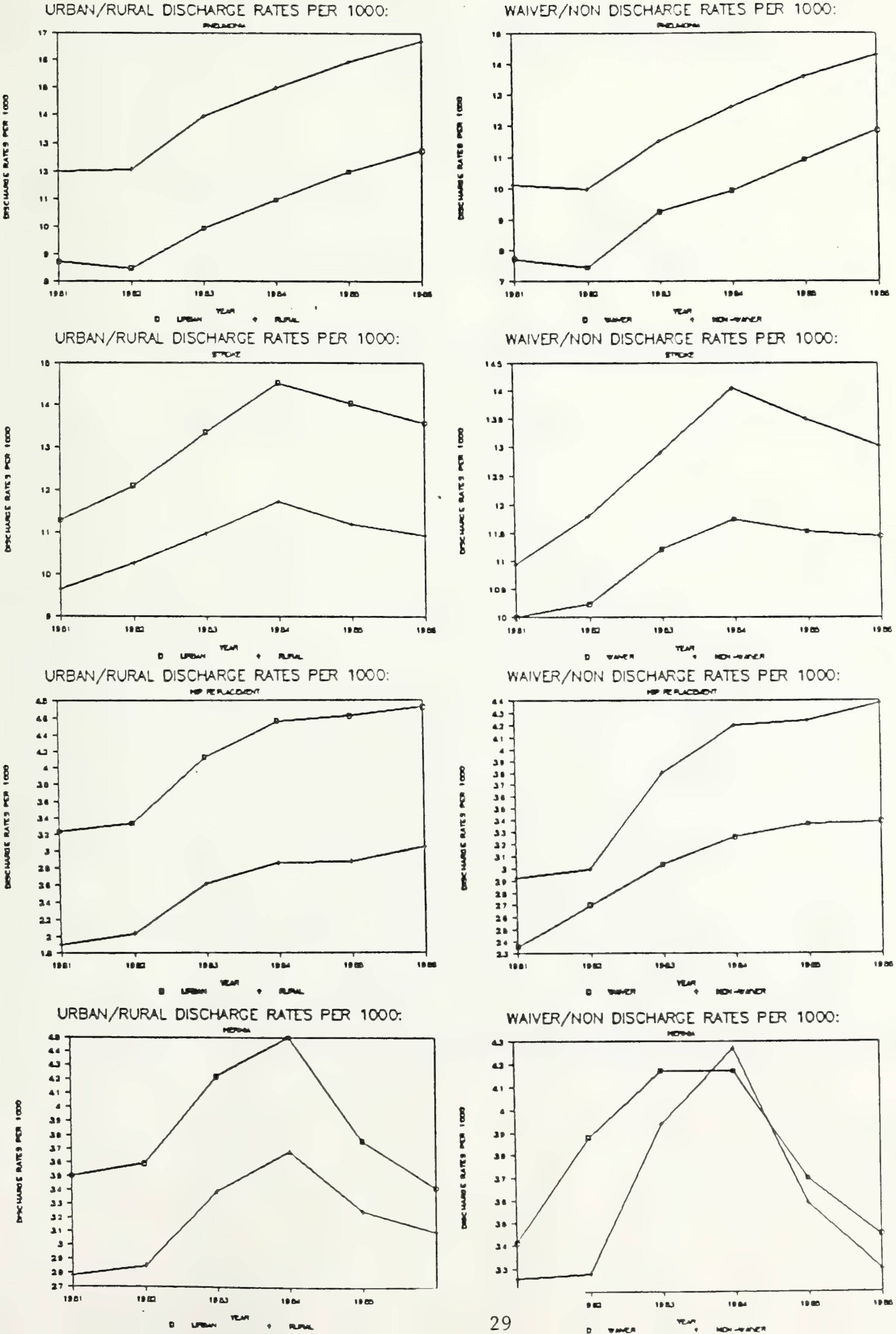

HERNIA DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ TOTAL
+ COMPLIC
◆ BILAT
▲ UNILAT
HIP REPLACE DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
YEAR
□ TOTAL
+ OSTEO
◆ FRACTURES
STROKE DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
YEAR
□ TOTAL
+ DRG 015
◆ DRG 005
▲ DRG 014
PNEUMONIA DISCHARGE RATE PER 1000
FOR TOTAL GROUP AND SUBGROUPS
DISCHARGE RATE PER 1000
YEAR
□ TOTAL
+ DRG 79,80
◆ DRG 89,90

Figure 5


URBAN/RURAL DISCHARGE RATES PER 1000:
PNEUMONIA
WAIVER/NON DISCHARGE RATES PER 1000:
PNEUMONIA
URBAN/RURAL DISCHARGE RATES PER 1000:
STROKE
WAIVER/NON DISCHARGE RATES PER 1000:
STROKE
URBAN/RURAL DISCHARGE RATES PER 1000:
HIP REPLACEMENT
WAIVER/NON DISCHARGE RATES PER 1000:
HIP REPLACEMENT
URBAN/RURAL DISCHARGE RATES PER 1000:
HERNIA
WAIVER/NON DISCHARGE RATES PER 1000:
HERNIA
DISCHARGE RATES PER 1000
YEAR
1981
1982
1983
1984
1985
1986
□ URBAN
+ RURAL
□ WAIVER
+ NON-WAIVER

to 1983 we also see that PPS states had much lower admission rates than waiver states; a differential that was essentially removed after 1983. The hernia data suggest that industry circumstances rather than treatment technology may have been influencing admission patterns. This may be noteworthy since hernia repair may be the most discretionary of the 4 tracers, and most amenable to substitution against inpatient hospitalization.

Statistical Analysis of Admissions

The statistical analysis of admissions is directed at three issues:

- Is there evidence that introduction of PPS in late 1983 influenced admission rates?
- Is there evidence that the market circumstances of hospitals and physicians have affected admission rates?
- Is there evidence that the PRO program has influenced admission rates?

Data

All measures of Medicare Part A utilization used in this study are drawn from the Abt Associates Twenty Percent BEAA-Quarter Per Capita Analytic File. This file contains aggregates of Part A utilization for inpatient, SNF and HHA care for all beneficiaries in the standard Twenty Percent HCFA samples. All measures appearing in the Analytic File, including reimbursements, admissions, covered days, and visits are aggregated from the beneficiary claim level to the BEAA Economic Area level for each quarter from 1981 QI to 1986 QIV based on the SSA state and county codes and the admission or from-dates present on the stay and bill records.[23] The BEAA Economic Areas were modified somewhat for this study in order to insure that waivered and nonwaivered areas were never contained in a single area. Each area that contained both urban and rural parts was also divided into its rural and urban county components. The resulting file contains utilization for each of 349 areas for 24 quarters. Medicare

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[23] Because of problems with missing data, claims from Alaska, Hawaii and Puerto Rico were not aggregated and these areas do not appear on the file.

enrollment totals for each area by year also appear on the file, allowing utilization to be computed on a per-beneficiary basis.[24]

Basic Model

It should be noted at the outset that there is no unambiguous and straightforward way of measuring the effects of the Prospective Payment System on quantities of or payments for health care provided under Part A of Medicare. Had PPS been implemented in a randomly selected group of hospitals or geographical areas while other hospitals or areas continued to be reimbursed at cost, then a proper comparison of changes in utilization and payment between the two groups could arguably constitute an unbiased estimate of the effect of PPS. In fact, PPS was implemented in all short-term hospitals in the U.S. on fiscal year anniversaries beginning on October 1, 1983. Only hospitals in the so-called waivered states (Maryland, Massachusetts, New Jersey and New York) were exempt. Each of these states had previously implemented some form of prospective reimbursement for Medicare inpatient hospital services; waivers were granted on the basis of these programs. Simple comparisons between states operating under PPS and states operating under waivers from PPS therefore cannot generate reliable estimates of the effect of changing from a system of cost reimbursement to a system of prospective payment on the utilization of Medicare services.

Even if PPS had been introduced randomly, some effects of prospective payment would probably be impossible to detect. Effects on admissions are particularly likely to be obscured by opposing influences. The PPS regulations did not simply replace cost reimbursement with prospective payment, but also instituted tighter peer review procedures. Interviews with hospital administrators and physicians, conducted by Abt Associates in late 1986 and described above, indicated a widespread effort to review admissions in light of criteria used by Peer Review Organizations (PROs). This concern over possible denial of payment for admissions as a result of PRO review is likely to

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[24] Readers should be aware that data were aggregated and appear in the file only if the appropriate claim appeared in the relevant HCFA sample. Clusters of missing claims are known to exist for particular areas at particular times resulting from disputes with intermediaries or from simple loss. Many of the quantities calculated on a "per enrollee" basis are therefore likely to be underestimated. For example, Part A reimbursement per enrollee as computed from this file is $1329, some ten percent lower than the $1521 cited by the U.S. General Accounting Office (1988). The consequences of such missing data for the empirical work reported here are difficult to assess and have not yet been explored.

attenuate and could even dominate the incentive to increase admissions when cost reimbursement is replaced by prospective payment. It will not be possible in general, to discriminate the effects of prospective payment from other aspects of PPS rulemaking (such as PRO review). Indeed, as the subsequent discussion suggests, distinguishing gross PPS effects is itself a formidable task.

The absence of a reliable comparison group eliminates the possibility of a straightforward estimator of PPS effects. The best means of approximating the effects of PPS on hospital admissions, rehospitalizations, length of stay, and other measures of medical care is probably to develop a set of "pre-post" comparisons as broad indicators. As a rule, comparisons of utilization and reimbursement before and after the inception of PPS are unlikely to reveal pure PPS effects. Changing private and governmental cost containment programs, evolving patterns of practice, and varying rates of change in input prices all influence levels of health care utilization. Differences before and after PPS are thus an amalgam of PPS effects and numerous other extraneous factors. "Pre-post" comparisons require PPS effects to be dominant in the period under study if the comparisons are to approximate these effects.

An alternative way to approximate the effect of PPS on some measure of utilization, say admission rates (ADM), is the "double difference" measure. If the superscripts W and P represent waivered and PPS states and if subscripts B and A represent periods before and after the implementation of PPS, then the double difference in admissions is:

$$\mathrm{DDL} = (\mathrm{ADM}_A^P - \mathrm{ADM}_B^P) - (\mathrm{ADM}_A^W - \mathrm{ADM}_B^W)$$

To the extent that influences on admission other than PPS affected nonwaivered and waivered states roughly equally, this "difference in differences" will estimate the effect of PPS on admissions. The terms in parentheses represent changes in admissions in nonwaivered and waivered states between time B and time A. If it is assumed that influences causing admissions to change are the same in the two areas except for the institution of PPS in the non-waivered states, then all effects save for PPS effects are differenced out of the equation and DDL is an unbiased estimator of PPS effects. The immediate disadvantage of the double-difference estimator is its greater sampling variance, roughly twice that of the pre-post (single difference) estimator. Which of the two has smaller bias is a matter of judgment and cannot be determined a priori. Bias in the pre-post estimator arises from factors other than PPS that cause admissions to

change during the period under study. Bias in the double-difference estimator arises from factors other than PPS that cause admissions to change in waiver states relative to nonwaiver states during the period. In general terms, the pre-post estimator will exhibit less bias to the extent that PPS is the dominant effect on admissions in nonwaivered states. The double-difference estimator will exhibit less bias if there are factors other than PPS causing admissions to change and if these other factors have similar effects in waivered and nonwaivered states.

The double difference estimator DDL may easily be replicated in a linear regression equation. If WAIVER is defined as an indicator variable which takes on a value of one for waivered states and zero otherwise and if POST is an indicator variable that takes on the value one for periods after the implementation of PPS and is zero otherwise, then the estimated regression coefficient β_3 in the equation below (estimated by ordinary least squares) is identical to DDL.

$$\text{ADM} = \beta_0 + \beta_1\text{WAIVER} + \beta_2\text{POST} + \beta_3(1\text{-WAIVER})*\text{POST} + \varepsilon \tag{4.1}$$

The efficiency with which this estimate of the effect of PPS on length of stay is estimated may be increased by adding other variables likely to be correlated with admissions to the right-hand side of equation (1).

Timing the Implementation of PPS

Further complicating the problems presented by the absence of a realistic comparison group is the temporal character of the PPS "treatment". Hospitals entered PPS on their fiscal year anniversaries, beginning on October 1, 1983. Some hospitals had not yet entered more than a year after this date, though a bare majority were subject to PPS by January, 1984. This phasing-in of PPS almost surely will muddy the observed effects when using a geographically aggegated file. Furthermore, the emergence of PPS effects may have preceded its implementation in some areas, due to anticipatory behavior by hospitals; the effects may have strengthened or diminished in the years after implementation as a result of learning. As a practical matter then, designating particular times as "before" and "after" PPS for purposes of constructing a pre-post

estimator (that is, deciding when POST should be set equal to one) is largely a matter of guesswork.[25] Since the file contains six years of data, alternative measures will be simple to construct, but no standard for selecting the best is available.

A related difficulty is the proper treatment of New York and Massachusetts. Both states received waivers from PPS and continued to operate under previously established state prospective reimbursement programs in 1984. In late 1985, however, Massachusetts hospitals lost their waivered status and joined the prospective payment system. New York hospitals joined PPS in January, 1986. The question is how to classify these two states in 1986. Recall that the rationale for the double difference estimator was that the variable WAIVER captures underlying differences between the four waivered states and all other states and that the change in hospital payment under PPS was assumed to be the only influence differentially affecting PPS and waivered states during the period. If WAIVER were set equal to zero for New York and Massachusetts in 1986, then characteristics specific to these two states would become confounded with PPS effects; if they continue to be classified as waivered states in 1986, then the PPS effect estimated by β_3 in equation (4.1), will be over- or underestimated to some extent, depending on whether the effect of PPS on length of stay is smaller or greater than the effect on length of stay of the New York and Massachusetts state reimbursement programs.

This paper adopts the latter strategy, defining New York and Massachusetts to be waivered states in 1986 and including a dummy variable equal to one for areas in the two states in 1986. As a check on the results, some equations were re-estimated with New York and Massachusetts eliminated from the data in 1986 and also with all data from 1986 removed. Neither procedure changed the estimates significantly.

Estimation of Market Influences

A fundamental assumption of the OLS regression model is that all covariates included on the right hand side of the equation must be independent of the disturbance term. Put more colloquially but perhaps more plainly, the covariate (or independent

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[25] The reimbursement provisions of TEFRA also hinder the selection of an appropriate "before" period. Most hospitals were subject to TEFRA in the year immediately preceding their entry onto PPS. Some features of PPS appeared, in somewhat milder form, in TEFRA. In particular, PPS was designed to be budget neutral with respect to the target reimbursements established by TEFRA. Under these conditions, it is unlikely that TEFRA and PPS influences could be clearly disentangled.

variable) included on the right hand side may influence the value of the dependent variable but is assumed not to be influenced by the dependent variable. In the presence of this reverse causation (more appropriately termed "simultaneity bias"), OLS fails to identify the true effect of changes in the covariate on the dependent variable.

Several variables used as covariates in this paper merit some discussion on this score. Hospital beds per capita, physicians per hospital bed, and nursing home beds per capita are included in all regressions reported in this paper as measures of local supply. Other things equal, more hospital beds per capita should result in more admissions per enrollee and longer average lengths of stay; more nursing home beds per capita should produce shorter lengths of stay and fewer admissions since these beds substitute (at the margin) for hospital beds. More physicians per bed may also signal more available substitutes for hospital care and more competition among physicians for patients and hospital privileges. Over the long run, however, the level of hospital and nursing home beds and physicians per bed are likely to adjust to local patterns of medical practice so that they may be determined to some degree by admissions and length of stay. The coefficients of these variables in OLS regressions must therefore be interpreted with caution.

An even greater problem is posed by the third variable, HMO membership per 100 population. The introduction and growth of HMOs in the U.S. has hardly been uniform. HMOs have generally been most attractive (especially to employers) in areas with high health care cost and utilization. The least squares coefficient of HMO enrollment per capita is then a blend of HMO effects on utilization and utilization effects on HMO enrollment. Mclaughlin (1988) finds no statistically significant effects of HMO enrollment on hospital expenses per capita or per admission after controlling for the tendency of HMOs to grow in areas with high expense. OLS regression models may document the association between membership and utilization but are unlikely to reveal the true effect of greater HMO enrollment on utilization. The fixed-effect model, discussed below, should provide improved estimates of the effect of all market variables.

Estimation Using a Time Series of Cross Sections

Yet another assumption of the OLS regression model is that disturbance terms (such as ε in equation (1)) are independent across observations. This assumption is untenable when using a dataset such as this one which contains 24 quarters of data for each geographical area. It is natural to expect that disturbances for different quarters for a particular area will be correlated with each other. This correlation is ignored in

OLS, but can be exploited to produce more precise estimates (i.e. estimates with smaller sampling variances) than are possible with OLS. A variety of generalized least squares (GLS) estimators can be specified; the exploration of alternative GLS specifications including autoregressive, random effects and ARIMA processes is a subject for future work. In this paper a simple fixed effect model will be estimated. The fixed effect model specifies the disturbance term for area i in quarter t as the sum of two components: a constant term f_i that is fixed for each particular area but varies across areas, and a purely random term v_{it} that is independent across areas and across time periods for a particular area. Thus

$$(4.2)\qquad \varepsilon_{it} = f_i + v_{it};\ E(\varepsilon_{it}\varepsilon_{jt'}) \begin{array}{ll} = f^2 + Var(v) & \text{for } i=j \text{ and } t=t' \\ = f^2 & \text{for } i=j \text{ and } t\neq t' \\ = 0 & \text{for } i\neq j \text{ and } i\neq t' \end{array}$$

The fixed-effect model as specified here is equivalent to adding a dummy variable for each study area. While this is wasteful of degrees of freedom, it provides an additional bonus. Any correlation between covariates and those elements of the disturbance that are fixed over time are captured by the fixed effect. The simultaneity bias induced by the inclusion of market variables may thus be reduced or eliminated.

One consequence of the method of used here to estimate the fixed effects model is that all variables not changing over time are impounded in f_i. Estimates are reported only for variables that change over time within a particular area.

Explanatory Variables

1) Seasonal and Trend Effects

Variable Names: SPRING, SUMMER, AUTUMN, AUT86DUM, DYR82-DYR86

Medicare utilization and expenditure display marked seasonality; they are usually highest in the winter and lowest in summer and autumn. The three indicator variables SPRING, SUMMER, and AUTUMN each take on a value of one in the second, third and fourth quarters of the year respectively, and otherwise equal zero.

The variable AUT86DUM takes on a value of one in the fourth quarter of 1986 and is zero otherwise. Some measures of utilization were found to decline sharply in this last quarter of the data. The decline is almost surely the result of lags in the processing of Medicare claims which therefore did not reach the appropriate HCFA analytic claims file. Inclusion of AUT86DUM as a covariate prevents the acquisition of high "leverage"

by observations in this period and the consequent mis-estimation of time trend and seasonal coefficients.

Time effects are captured by the indicator variables DYR82 through DYR86. Each of these variables takes on a value of unity if the observation occurred in a year equal to or greater than the year of the variable name. Thus DYR83, for example, is set equal to one for the years 1983 through 1986 and is zero otherwise. By defining the year variables in this way, the coefficient of each year indicator is made to estimate the increase in the dependent variable (other things constant) over the previous year.

2) Market and Location Effects

Variable Names: URBAN, BENPOP, PHYSPOP, PHYSPOP#, HMOPOP, HMOPOP#, HBEDPOP, HBEDPOP#, NBEDPOP, NBEDPOP#, REGION2-REGION5

URBAN is an indicator variable that takes on a value of one if an area is comprised of one or more Metropolitan Statistical Areas (MSAs) and is zero otherwise. The areas were defined so as not to cross urban-rural boundaries.

BENPOP measures the number of Medicare Part A enrollees per 100 people in the study area. Patterns of medical practice are likely to be more oriented toward Medicare financing policies and rulemaking in areas with a relatively high concentration of enrollees than in other areas. Enrollees in these areas may also be more informed about covered and noncovered services available under Medicare. In some specifications of the regression model, the interaction of BENPOP and the year indicators DYR82-DYR86 is included as an indicator of PPS effects as discussed below.

MDBED is the number of patient care doctors per hospital bed in an area. It is a crude measure of the extent of availability and competition among physicians in an area. The value of PHYSPOP is unavailable for the years 1984 through 1986. For each of these years, PHYSPOP retains its 1983 value for the years 1984 through 1986.

HMOPOP is the number of HMO enrollees per 100 population in an area. It is included as a covariate in the regression equations estimated here, but its measured effects must be interpreted with caution. While HMO growth may affect the level of utilization and medical cost in an area, HMOs thenselves are most likely to appear and flourish in areas with relatively high levels of medical cost. The coefficient of HMOPOP may therefore be regarded as a blend of causes and effects and cannot, in general, be interpreted as showing the effect of changes in HMO membership on utilization. HMOPOP is unavailable for 1986; for this year, HMOPOP takes on its 1985 value. The

variable HMOPOP# takes on the 1985 value of HMOPOP in 1986 and is zero otherwise as described for the variable PHYSPOP#.

HBEDPOP is the number of hospital beds per capita population in the area. This variable may be regarded as a crude measure of the extent of hospital competition in the area; in the absence of a measure of the number of hospitals, however, its usefulness is limited. Numerous studies have documented a positive association between the availability of hospital beds in an area and hospital use (Roemer and Shain 1959; Newhouse and Phelps 1976; Ginsburg and Koretz 1983). HBEDPOP is missing for 1985 and 1986. The variable HBEDPOP# has been defined in the same manner as were PHYSPOP# and HMOPOP# above.

NBEDPOP is the number of nursing home beds per capita in the area. Since nursing home care is often a substitute for the last days of a hospital stay for many elderly patients, a negative association between hospital utilization and nursing home beds might be expected. This substitution can be quite difficult to measure empirically, since actual use of hospital versus nursing home care depends not only on availability of beds but also on the relative prices facing physicians and families. NBEDPOP is available only for 1981 and so takes on the same value for a given area in all years. The variable NBEDPOP# was created in the same way as HBEDPOP# above.

REGION2-REGION5 are regional indicator variables designed to control for gross differences in practice patterns among various areas of the country. While these variables are defined on the basis of specific BEAAs which do not follow state lines, the state composition of the areas is roughly as follows:

REGION2: VA, NC, SC, GA, FL ,AL, TN, KY, WV, AR, LA
REGION3: OH, MI, IN, IL, WI, IA, MO, OK, TX
REGION4: KS, NE, SD, ND, MT, WY, CO, NM, UT, ID
REGION5: AZ, NV, WA, OR, CA

3) Other Variables

Variable Names: WAIVER, MANY86, PPS82 86

WAIVER is an indicator variable that takes on a value of one for areas in states that were granted waivers from the hospital payment rules of the Prospective Payment System (Maryland, Massachusetts, New Jersey, New York). For all other areas, WAIVER is set equal to zero.

MANY86 is an indicator variable set equal to one for areas of Massachusetts and New York for the year 1986 and is zero otherwise. Both states entered PPS in

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1986. Redefining the value of WAIVER to equal zero in 1986 for these states would likely produce misleading results as argued in the last chapter. This variable is designed to capture changes in these states resulting from their entry to PPS and so mitigate bias in the coefficient of WAIVER.

PPS and Admission Rates

Table 1 reports selected parameters from regression models on quarterly hospital admission rates. The first three columns represent OLS models that pool urban and rural areas (TOTAL) and treat both areas separately. The fourth model pools urban and rural together and uses a fixed effects specification, which essentially controls for base differences across regions. The models appear in full in an appendix.

All models show strong temporal and seasonal influences on admission rates. From Q1 1981 to Q4 1983 there was a marked increase in admission rates per capita, followed by an even larger decline in the next eight quarters. In 1986 admission rates increased in urban areas, but not in rural places (where base level admission rates are generally higher). In all areas the winter quarter (omitted) has the highest admission rates, with the summer and fall showing the lowest rates (about 6-7% lower than winter). The seasonal pattern is most pronounced for rural places, where the summer/fall period rates are about 10% lower than winter.

The time trends in the PPS states (controlling for general trends and waiver/nonwaiver base differences) are reflected in the PPSYY variables. They show a pattern of falling admission rates from 1981 through 1986. Admission rates fell markedly in these states (relative to general trend) in 1981-82, experienced insignificant reductions from 1982-84, a sharp reduction in 1985 and no significant change from 1985 to 1986. This general pattern is consistent across specifications. Looking at the GLM specification, which we prefer, the PPS states experienced a sharp chop in admissions (about 16%) between 1981 and 1982. Relative admission declines were not again significant until 1984-85, when there was a 34% relative drop in admissions.

This pattern is not consistent with a change in admitting behavior corresponding to the onset of PPS during 1984 for most hospitals, though the relative reduction in admitting rates in 1985 may reflect a PPS effect since this represents the first full year of PPS coverage for most hospitals. The 1985 effect is strong in all models, though insignificant in rural areas. When terms for 1984-86 are pooled, the coefficient is negative and significant; this suggests a significant average reduction in admissions in the post PPS period, relative to the pre period, controlling for the trend observed in

Table 1: Selected Coefficients from Hospital Admission Rate Models[a]

Selected Covariate[b]	OLS Total	OLS Urban	OLS Rural	GLM/Fixed Effects Total
1982	.0114+	.0104+	.0065	.0080+
1983	.0041+	.0039+	.0048	.0023+
1984	-.0122+	-.0099+	-.0099+	-.0128+
1985	-.0097+	-.0072+	-.0069*	-.0105+
1986	.0017	.0103+	-.0022	.0008
Spring	-.0031+	-.0026+	-.0043+	-.0031+
Summer	-.0063+	-.0053+	-.0088+	-.0063+
Autumn	-.0068+	-.0052+	-.0105+	-.0068+
PPS82	-.0022*	-.0026*	.0024	-.0015*
PPS83	-.0016	-.0012	-.0024	-.0012
PPS84	-.0010	-.0015	-.0023	-.0009
PPS85	-.0031+	-.0028*	-.0042	-.0029+
PPS86	-.0007	-.0028	.0083	-.0011
Urban	-.0076+			
R^2	.658	.600	.662	.869
N	8339	4027	4311	8376
Dependent Mean	.0890	.0837	.0992	.0890

+ $p \leq .01$
* $p \leq .05$

[a] Weighted by number of eligible beneficiaries per area per quarter.

[b] Other included covariates are reported in the full model, which appears in Appendix A.

waiver states. While simple, this test fails to reflect the dominance of one year (1985) of data in the post PPS period and the ambiguity in the interpretation of the timing in measured differences.

Our general interpretation of these findings is that PPS did not cause admissions to increase, as was anticipated, and was likely associated with a one-time reduction in admission rates, in 1985. This timing is consistent with the operational startup of the PRO contracts in PPS states; most contracts were signed in 1984, but operations generally began in Q4 1984 and early 1985. The nature of the direct and sentinel effects of PRO review of admission necessity would be consistent with the pattern of measured effects; e.g., a one-time sharp change in physician admitting behavior.[26] Requirements that forced substitution of outpatient for inpatient surgery and imposition of more restrictive admitting criteria would be expected to create one-time shifts in the structure of admissions. Case studies done by HER and Abt did suggest that "social admissions" (no medical necessity and no Medicare payment) were largely eliminated under pressure by PROs.

The question of whether the effects might be due to direct denials by PROs or through general sentinel pressures on questionable admissions is not easy to answer with available data. In an analysis of state-level data, Hassol and Olinger (1988) fail to find a significant correlation between admission rates and PRO denial rates, suggesting that direct denials are not the mechanism of effect. Our work (below) suggests that admissions are sensitive to a measure of PRO review stringency, which is weak support for the sentinel mechanism. However, the pattern of results we report in Table 1 in no way demonstrates a conclusive effect of the PPS program in general, or the PRO component of that program in particular.

Changes in Admissions, PROs and Market Effects

The anomalous decline in Medicare admissions experienced by most hospitals following the introduction of PPS may possibly be explained by the concomitant initiation of a stricter utilization review program performed by professional review organizations (PRO). The PROs first operated in 1985, the year when the largest decline in admissions is seen.

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[26] A companion paper by Hassol and Olinger (1988) reviews the operational activities of PRO and FI's as part of the PPS.

In this section of the paper we estimate the effect of the PROs along with that of various market variables on the change in admission rates between 1982 and 1986 and between 1982 and 1985. The unit of analysis is still a market area defined by a BEAA, divided into urban and rural components. The dependent variables in the regressions are the percentage change in the Medicare admission rate (number of admissions/number of Medicare Part A enrollees) over the years mentioned above. The percentage change in the admission rate is used rather than the level admission rate to abstract from underlying differences in the level of admissions across market areas. This approach, rather than the pooled time-series/cross-section, is indicated because the PRO measure we use is available only cross-sectionally, and only for PPS states. Waiver state BEAAs are omitted for this work.

The 1983 values of various other market variables that are thought to affect admission rates and changes therein are included as well. Since 1983 values of these variables are used while the admission rate change is measured from 1982 to 1985 or 1986, the problem of potential endogeneity that is present in level regressions should be minimized. In all cases, negative coefficients indicate that a variable is associated with larger declines in admissions. We also include a base period admission rate (1982) in the model to control for other omitted influences on area variations in admission patterns. Results are shown in Table 2.

The variable used to measure the stringency of an area's PRO is the SuperPRO's evaluation of the percentage of inappropriate admissions that was flagged by the PRO (PRORATE). Ratings for the first two six month cycles, which occurred during 1985, are included in the data set. Since the response to PRO sanctions might occur with a lag, it is expected that this variable will have a stronger effect on the 1982-1986 change in admissions than that between 1982 and 1985. The variable ranges from 3 to 63 percent in 1985. As predicted, the variable has a negative and significant effect on the 1982-1986 change in the admission rate. The effect on the 1982-1985 change is very small and totally insignificant. These results suggest that the PROs did significantly change admission behavior after operating for a year, although the coefficients are small in magnitude.

A dummy variable indicating whether the BEAA market is an urban (as opposed to rural) area (BTYPE) is included. Since rural hospitals have suffered more under PPS, it might be expected that this variable would have a positive effect, i.e. the change in admissions would be positive (or less negative) in urban areas. Instead the coefficient is

Table 2: Models on Admission Changes
(Percent Change in Admission Rate Per Capita)

Covariate[a]	1982/85 Model 1	1982/86 Model 2	1982/86 Model 3
Intercept	-.110*	-.180+	-.210+
Urban	-.008	-.015	-.015
Per Cap. Income	-.007+	-.008+	-.008+
BSNSS	-.456	-.117	-.425
HMO Pop	-.000	-.000*	-.000+
NH Bed Pop	-.004+	-.005+	-.006+
Outp. Pop	-.003	-.005	-.006
Hosp Bed Pop	-.002	.003	.002
MD Charge	-	-	.009+
MD Pop	-.001	-.006	-
SpecMd Pct	.140+	.119+	.119+
Occup Rate	.065	.203+	.203+
Qtr 1	.074+	.131+	.130+
Qtr 2	-.020*	.064+	.063+
Qtr 3	-.014	.055+	.054+
PROrate	.000	-.001+	-.001+
ADMIT82	-4.987+	-8.171+	-7.098+
N	1123	1123	1123
R^2	.236	.392	.423

+ $p \leq .01$

* $p \leq .05$

[a] Models using only the first quarter of each year were also estimated, with similar results.

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insignificant and changes according to specification. This suggests that rural hospitals, relative to their urban counterparts, did not suffer larger declines in admissions.

A variable measuring per capita income (CAPINC) also shows a negative coefficient, presumably for the same reason as the urban dummy variable.

In areas with a high concentration of large employers there might be more pressure on hospitals to contain admissions as business attempts to control its health care expenditures. While the dependent variable measures the change only in Medicare admissions, it would not be surprising to see a spillover effect as practice patterns are generally changed. BSNSS is measured as the fraction of an area's population that is employed by business establishments with more than 5000 workers. As expected, this variable shows a negative sign, albeit only marginally significant.

Similarly, areas where a larger proportion of the population is enrolled in HMOs (HMOPOP) shows a greater decline in admissions between 1982 and 1986. (The effect on the 1982-1985 change is small and insignificant.) Again, it is not surprising that the utilization controls exerted by HMOs lead to greater declines in admissions. Many studies find that the level rate of admissions is positively associated with HMO variable in such a specification if HMOs entered first in those areas in greatest need of utilization control.

Since nursing home care may substitute for some hospitalizations, areas with a high ratio of nursing home beds per population (NHBPOP) might offer a greater potential for substitution of outpatient care. Therefore, it is not surprising that NHBPOP is also associated with a decline in admissions.

The number of outpatient visits consumed per capita (OUTPPOP) could be expected to have a similar effect if outpatient care is a substitute for inpatient care. This does not seem to be the case, however. The variable is insignificant.

The level of the admission rate for 1982 (ADMIT82) is included as an explanatory variable to test whether there has been any significant convergence in admission rates over time. Its significant negative coefficient implies that in those areas with the highest admission rates prior to PPS admissions fell the most. This suggests that convergence has indeed occurred.

It has often been noted that the number of hospital beds per capita (BEDPOP) is associated with a higher admission rate. This, it is thought, suggests supply-induced demand. While this might be the case, areas with high bed densities were unable to preserve their high admission rates between 1982 and 1986. Once the 1982 level of

admissions is controlled for, the bed-population effect has no significant effect on the change in the admission rate.[27]

Holding the bed-population ratio constant, markets with higher hospital occupancy rates (OCCRATE) appear to have better protected their admissions and show smaller declines. This suggests that those hospitals that were more attractive to physicians and patients prior to the decline in admissions remained so.

A market's physician-population ratio (MDPOP) in a market has no effect on the rate of change in the area's admission rate when the 1982 level of admissions is held constant.[28] A high proportion of physicians who are specialists (SPECMD), however, appears to protect the admission rate. Specialist's admitting patterns appear to have been less susceptible to downward pressures on admission rates in the 1980s.

The physician-population ratio does not provide a clear measure of physician market power since it is difficult to determine whether a larger supply of physicians is induced by more competition or by greater demand. A measure of physician charges may be more indicative of physician power. The area's prevailing charge for general practice deflated by the CPI (MDCHARGG) is used (for 1984). It shows a strong positive relation with the change in the admission rate, suggesting that areas with greater physician market power showed less of a drop in admissions. This suggests that the PROs (or other forces) were less able to change physician practice patterns in areas where physicians evidenced greater market power.

Finally, the significance of the quarterly dummy variables in the regression on all four quarters suggests that seasonality played an important role in admission rate changes. The mean rate of decline varies significantly across quarters, ranging from 14 percent in the first quarter to 26 percent in the fourth. Running regressions on each of

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[27] When the 1982 admission rate is omitted from the regression, the bed-population rate has a significant negative coefficient, suggesting that those areas with the most beds had the largest drop in admissions. The explanation for this relation appears to be the positive correlation between bed-population ratios and the level of admission rates. A herfindahl index on beds was also used in earlier work but was not significant. We omit it in the final models because we doubt the validity of the BEAA market area as a good approximation of a hospital's market place for this kind of concentration measure of hospital market power.

[28] If the level admission rate is omitted the physician population ratio has a significant positive effect on the rate of change in admissions (admissions fell less in areas with lots of physicians), implying that the physician-population ratio is negatively associated with the level admission rate.

the four quarters' data separately, however, does not produce much variation in most of the coefficients, although the levels of significance fall due to the fewer degrees of freedom.

PRO Stringency and Admissions

The suggestion of a PRO-sponsored explanation for the time pattern of effects in Tables 1 and 3 promoted further empirical work. Since we had no data on the actual implementation data of PROs across the PPS states, we chose to examine the association between the stringency of PRO reviews and admission rates using a more limited data set. Two stringency measures were available; one for the period January to June, 1985 and the other from July to December, 1985 based on Super PRO review cycles. Using essentially the same covariate as in Table 1, delimiting earlier quarters and omitting waiver state observations we tested 5 cross-sectional models:

$$A_{86} = f(PRO_{86}, \text{covariate})$$

$$A_{85} = f(PRO_{85}, \text{covariate})$$

$$A_{86} = f(PRO_{85}, A_{86}, \text{covariate})$$

$$A_{86} - A_{85} = f(PRO_{85}, \text{covariate})$$

$$A_{86} - A_{82} = f(PRO_{85}, \text{covariate})$$

where

A_{yy} = admissions per capita in the 1st quarter of the designated year (Jan., Feb., Mar.)

PRO_{yy} = stringency ratio, as defined in the text.

Table 4 displays the PRO coefficients; models appear in an appendix.

We fail to find any association between 1986 admission rate levels and the 1986 stringency measure. We do, however, find evidence of association between admission rates and lagged stringency measures and between changes in admission rates and stringency. The coefficients are very small, but statistically significant.

The interpretation on the signs is that an increase in PRO stringency, as measured by Super PRO, is associated with a reduction in admission rates in the future. This lag is consistent with the notion of a sentinel influence of the PROs; relatively stringent PROs (as indicated in their first year of operation--1985) may have led to

Table 3: PRO Stringency and Admission Models

PRO Measure	Dependent Variable Q1 1986 Admits/Capita	 Q1(1986-1985) Admits/Capita	 Q1(1986-1982) Admits/Capita
Dependent Mean	.0884	-.0043	-.0151
1986 PRO Stringency	.00006		
1985 PRO Stringency	-.00018+	-.00026+	-.00025+
1986 PRO Stringency with Q1 1985 Admits on RHS of Model	-.00010+		

+ $p \leq .01$

* $p \leq .05$

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subsequent reductions in admissions as significant numbers of questionable admissions were not being recommended by physicians.

This analysis does not suggest that the PRO portion of the PPS program was the responsible agent in explaining the drop in (the downward) admission trend in PPS states. That drop, which appears as a one-time fall in admissions in CY 1985 is not easily explicable on the basis of PPS marginal financial incentives imposed on hospitals, which began as early as late 1983. These findings do suggest an association between PRO review stringency and admission rates, when coupled with the fact that most PROs were not operational until late 1984/early 1985, may supply a tentative argument that PROs played a significant role in the reduction of Medicare admission rates in the post PPS period.

Discussion of Results

Hospital admission rates for Medicare beneficiaries have fallen markedly since 1983, and relatively faster in PPS states. While the nature of the absolute and relative decline cannot be fully understood from this analysis, we do suspect that the general decline is largely due to technological changes (e.g., cataracts). But we do find evidence that there is sufficient "discretion" in admitting practices to allow variations in market and regulatory factors to be systematically related to admission rates.

There are several reasons for believing that substantial discretion exists. We find evidence that the relative decline in admissions is higher following the year when PROs were introduced by Medicare. We also find evidence that the regional variation in PRO stringency is associated with admission rates. Third, we find evidence that PRO stringency influences are strongest when they are related to admissions in the subsequent year; suggesting a sentinel-type influence on discretionary admissions rather than a contemporaneous or direct-denial effect. And possibly most important, we find the percentage decline in admission rates in the mid-1980s to be largest in those areas where base admission rates were highest; this convergence is not observed for length of stay. The convergence suggests that whatever technologic, market and regulatory efforts were at work in the mid-1980s may have tended to have more impact on places where more discretionary or marginally necessary admissions were present in the base admission rate.

The results on market influences and the variability in PRO stringency do suggest that there may be potential for further declines in admission rates. Inter-area differences in admission rate changes over the 1982-86 period are strongly associated with some market characteristics (which we would not expect if admissions were driven

only by clinical considerations). Declines in admissions have been smaller the more market fee-setting power of physicians and more specialty-intensive the supply, the higher the base hospital occupancy rate, the weaker the PRO stringency, the less available are nursing home beds and HMOs, and the lower the per-capita income. These findings are generally consistent with expectations, and suggest that systematic sources of non-clinical differences in admission rates exist across areas. These patterns also suggest the value of behavioral models of discretionary admission/decision-making as we provide.

The results offered here are not definitive. We suggest that PRO oversight of admission necessity may have complemented a strong national trend in admissions. We cannot estimate the size of the PRO program effect, nor can we say for sure that the associations we observe are definitely due to the PRO intervention. A more focused assessment of PRO activity and review targeting would be needed to build confidence that our evidence on differential admission trends is likely due to PRO oversight.

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PPSBEN/PPSGG03: HOSPITAL ADMITS GLM WEIGHT=E001 WAIVER/NON-WAIVER                          13:23 FRIDAY, JANUARY 6, 1989     2

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: HSAPEN_A    HOSP ADMITS PER ENROLLEE-AGED
WEIGHT:             E001        ENROLLEES,PART A,AGED,ALL

SOURCE                 DF        SUM OF SQUARES          MEAN SQUARE        F VALUE           PR > F        R-SQUARE            C.V.

MODEL                 377       145975.84339767         387.20382864         139.61           0.0001        0.868599       1776.9388

ERROR                7962        22083.09299246           2.77356104                        ROOT MSE                    HSAPEN_A MEAN

CORRECTED TOTAL      8339       168058.93639013                                           1.66540116                      0.09372305


SOURCE                 DF           TYPE I SS      F VALUE      PR > F           DF         TYPE III SS      F VALUE       PR > F

PLACE                 347     104753.89456091       108.84      0.0001
D82                     1         30.79761641        11.10      0.0009            1        424.05947346       152.89       0.0001
D83                     1       6352.51301744      2290.38      0.0001            1         36.71498207        13.24       0.0003
D84                     1      14925.72132894      5381.43      0.0001            1        623.23837083       224.71       0.0001
D85                     1       8906.93094973      3211.37      0.0001            1        368.43534051       132.84       0.0001
D86                     1        879.71172497       317.18      0.0001            1          0.54784319         0.20       0.6567
SPRING                  1        305.91356140       110.30      0.0001            1        769.41675684       277.41       0.0001
SUMMER                  1        611.81907056       220.59      0.0001            1       3169.68407652      1142.82       0.0001
AUTUMN                  1       4866.13091682      1754.47      0.0001            1       3149.16166031      1135.42       0.0001
Q486DUM                 1        679.22772833       244.89      0.0001            1        679.22772833       244.89       0.0001
BENPOP                  1          0.50702055         0.18      0.6690            1         12.45903210         4.49       0.0341
HBEDPOP                 1        262.32421250        94.58      0.0001            1        168.07022340        60.60       0.0001
_HBEDPOP                1         71.34334989        25.72      0.0001            1          7.72805323         2.79       0.0951
HMOPOP                  1        333.62057009       120.29      0.0001            1          1.65584526         0.60       0.4397
_HMOPOP                 1        188.12057635        67.83      0.0001            1          2.37835942         0.86       0.3545
NW82                    1        399.06495928       143.88      0.0001            1         14.34262798         5.17       0.0230
NW83                    1        382.46951547       137.90      0.0001            1         10.30631568         3.72       0.0539
NW84                    1        415.58000032       149.84      0.0001            1          4.92567124         1.78       0.1827
NW85                    1         87.97648628        31.72      0.0001            1         55.25188002        19.92       0.0001
NW86                    1          4.38180917         1.58      0.2088            1          3.79946218         1.37       0.2419
MANY86                  1          4.77152126         1.72      0.1897            1         14.58900330         5.26       0.0218
HERFINDX                1          0.00002813         0.00      0.9975            1          1.62945531         0.59       0.4434
EDUC                    1          1.87846511         0.68      0.4106            1         41.57460886        14.99       0.0001
BSNSS                   1          6.34307574         2.29      0.1305            1          0.15660786         0.06       0.8122
OUTPPOP                 1         36.07499700        13.01      0.0003            1         37.56745887        13.54       0.0002
MDBED                   1         76.37574951        27.54      0.0001            1          1.28841849         0.46       0.4955
CAPINC                  1         20.41373818         7.36      0.0067            1          3.54458379         1.28       0.2583
_MDBED                  1        998.69713996       360.08      0.0001            1        798.89898244       288.04       0.0001
_BSNSS                  1          0.69999353         0.25      0.6154            1          7.95114470         2.87       0.0905
_OUTPPOP                1        365.22196053       131.68      0.0001            1        368.08132601       132.71       0.0001
_CAPINC                 1          7.31775331         2.64      0.1043            1          7.31775331         2.64       0.1043


                                         T FOR H0:      PR > !T!        STD ERROR OF
PARAMETER               ESTIMATE       PARAMETER=0                        ESTIMATE

D82                   0.00796236             12.37        0.0001          0.00064394
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PPSBEN/PPSGG03: HOSPITAL ADMITS GLM WEIGHT=E001 WAIVER/NON-WAIVER                          13:23 FRIDAY, JANUARY 6, 1989    3

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: HSAPEN_A   HOSP ADMITS PER ENROLLEE-AGED

                                         T FOR H0:     PR > !T!          STD ERROR OF
PARAMETER                 ESTIMATE      PARAMETER=0                        ESTIMATE

D83                     0.00226889             3.64      0.0003            0.00062361
D84                    -0.01276472           -14.99      0.0001            0.00085154
D85                    -0.01051554           -11.53      0.0001            0.00091237
D86                     0.00080704             0.44      0.6567            0.00181587
SPRING                 -0.00312806           -16.66      0.0001            0.00018781
SUMMER                 -0.00634896           -33.81      0.0001            0.00018781
AUTUMN                 -0.00676118           -33.70      0.0001            0.00020065
Q486DUM                -0.00631485           -15.65      0.0001            0.00040353
BENPOP                  0.00075437             2.12      0.0341            0.00035593
HBEDPOP                 5.62236257             7.78      0.0001            0.72225794
_HBEDPOP               -0.22638057            -1.67      0.0951            0.13561975
HMOPOP                4.2530571E-05            0.77      0.4397            0.00005504
_HMOPOP               2.3103340E-05            0.93      0.3545            0.00002495
NW82                   -0.00146483            -2.27      0.0230            0.00064416
NW83                   -0.00122846            -1.93      0.0539            0.00063728
NW84                   -0.00088407            -1.33      0.1827            0.00066340
NW85                   -0.00286048            -4.46      0.0001            0.00064089
NW86                   -0.00113061            -1.17      0.2419            0.00096598
MANY86                 -0.00225129            -2.29      0.0218            0.00098161
HERFINDX               -0.01573660            -0.77      0.4434            0.02053092
EDUC                    0.00738281             3.87      0.0001            0.00190689
BSNSS                  -0.00933919            -0.24      0.8122            0.03930259
OUTPPOP                -0.00228041            -3.68      0.0002            0.00061962
MDBED                   0.00443110             0.68      0.4955            0.00650132
CAPINC                 -0.00020706            -1.13      0.2583            0.00018316
_MDBED                  0.02045248            16.97      0.0001            0.00120509
_BSNSS                 -0.04467103            -1.69      0.0905            0.02638336
_OUTPPOP                0.00462687            11.52      0.0001            0.00040164
_CAPINC                -0.00018176            -1.62      0.1043            0.00011190
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DEP VARIABLE: HSAPEN_A HOSP ADMITS PER ENROLLEE-AGED

                       SUM OF         MEAN
SOURCE       DF       SQUARES       SQUARE       F VALUE       PROB>F

MODEL        38        110596     2910.433       420.440       0.0001
ERROR      8301     57462.476     6.922356
C TOTAL    8339        168059

    ROOT MSE         2.631037     R-SQUARE        0.6581
    DEP MEAN         0.088294     ADJ R-SQ        0.6565
    C.V.              2979.85

                    PARAMETER      STANDARD   T FOR H0:                    VARIABLE
VARIABLE   DF        ESTIMATE         ERROR  PARAMETER=0   PROB > [T[        LABEL

INTERCEP    1        0.175111   0.003922389      44.644       0.0001   INTERCEPT
D82         1        0.011414   0.001122279      10.170       0.0001
D83         1     0.004051109   0.000922925       4.389       0.0001
D84         1       -0.012182   0.001312879      -9.279       0.0001
D85         1     -0.00970271   0.001409917      -6.882       0.0001
D86         1     0.001668232   0.002786439       0.599       0.5494
SPRING      1     -0.00312806  0.0002967025     -10.543       0.0001
SUMMER      1     -0.00634896  0.0002967025     -21.398       0.0001
AUTUMN      1     -0.00676118  0.0003169946     -21.329       0.0001
Q486DUM     1     -0.00631485  0.0006375029      -9.906       0.0001
BENPOP      1     -0.00050732  .00004786786     -10.598       0.0001
HBEDPOP     1        2.325114      0.144056      16.140       0.0001
_HBEDPOP    1       -0.080693      0.212246      -0.380       0.7038
HMOPOP      1    .00008443193  .00002940257       2.872       0.0041   % OF POP ENR IN HMO (SMSA OR COUNTY)
_HMOPOP     1    .00001340871  .00003691061       0.363       0.7164
URBAN       1      -0.0076069  0.0003840519     -19.807       0.0001
REGION2     1     0.008186211  0.0004743073      17.259       0.0001
REGION3     1     0.006410779   0.000465411      13.774       0.0001
REGION4     1    -0.000430225  0.0005128855      -0.839       0.4016
REGION5     1      -0.0027264  0.0004575097      -5.959       0.0001
NBEDPOP     1        0.158616      0.096542       1.643       0.1004
_NBEDPOP    1       -0.170038      0.101760      -1.671       0.0948
NW82        1     -0.00218423   0.001008801      -2.165       0.0304
NW83        1     -0.00162454  0.0009999313      -1.625       0.1043
NW84        1     -0.00103796   0.001040201      -0.998       0.3184
NW85        1     -0.00310812   0.001007138      -3.086       0.0020
NW86        1    -0.000674087     0.0014718      -0.458       0.6470
WAIVER      1     -0.00815066  0.0007670742     -10.626       0.0001
MANY86      1     -0.00144049   0.001447618      -0.995       0.3197
HERFINDX    1       -0.037830   0.002823509     -13.398       0.0001
EDUC        1     -0.00457771  0.0003572515     -12.814       0.0001   MEDIAN SCHOOL COMPLETED IN 1970
BSNSS       1        0.225801      0.024278       9.301       0.0001
OUTPPOP     1     -0.00204962  0.0003686251      -5.560       0.0001
MDBED       1       -0.047477   0.001941934     -24.448       0.0001
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PPSBEN/PPSGG01: HOSPITAL ADMITS REGS WEIGHT=E001 WAIVER/NON-WAIVER                    14:45 FRIDAY, DECEMBER 30, 1988    2

                   PARAMETER      STANDARD   T FOR H0:                      VARIABLE
VARIABLE  DF        ESTIMATE         ERROR  PARAMETER=0   PROB > [T[          LABEL

CAPINC     1 -0.000960744 0.0001207654        -7.955       0.0001  MEAN PER CAPITA INCOME (TEBI)
_MDBED     1     0.020639  0.001806544        11.425       0.0001
_BSNSS     1   -0.0034277     0.040197        -0.085       0.9320
_OUTPPOP   1  0.003974488 0.0006090683         6.526       0.0001
_CAPINC    1 -0.000277245 0.0001744215        -1.590       0.1120
```

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PPSBEN/PPSGG02: HOSPITAL ADMITS REGS WEIGHT=E001 WAIVER/NON-WAIVER                    14:52 FRIDAY, DECEMBER 30, 1988    1
URBAN

DEP VARIABLE: HSAPEN_A HOSP ADMITS PER ENROLLEE-AGED

                        SUM OF          MEAN
SOURCE      DF         SQUARES        SQUARE       F VALUE       PROB>F

MODEL       37       40969.388      1107.281       161.539       0.0001
ERROR     3990       27349.749      6.854574
C TOTAL   4027       68319.137

    ROOT MSE          2.618124      R-SQUARE        0.5997
    DEP MEAN          0.083710      ADJ R-SQ        0.5960
    C.V.              3127.597

                     PARAMETER      STANDARD    T FOR H0:
VARIABLE  DF          ESTIMATE         ERROR  PARAMETER=0   PROB > [T[      VARIABLE
                                                                              LABEL

INTERCEP   1          0.073725   0.007671851        9.610       0.0001  INTERCEPT
D82        1          0.010366   0.001468697        7.058       0.0001
D83        1   0.003881539       0.000965616        4.020       0.0001
D84        1   -0.00994708       0.001700624       -5.849       0.0001
D85        1   -0.00723491        0.00173655       -4.166       0.0001
D86        1          0.010254   0.003936731        2.605       0.0092
SPRING     1   -0.00262239  0.0003518183       -7.454       0.0001
SUMMER     1   -0.00532257  0.0003518183      -15.129       0.0001
AUTUMN     1   -0.00517947   0.000375947      -13.777       0.0001
Q486DUM    1   -0.00709169  0.0007552207       -9.390       0.0001
BENPOP     1  -0.000729749  .00005828654      -12.520       0.0001
HBEDPOP    1      2.075672      0.183829       11.291       0.0001
_HBEDPOP   1     -0.029223      0.282934       -0.103       0.9177
HMOPOP     1  -.0000483576  .00003280797       -1.474       0.1406  % OF POP ENR IN HMO (SMSA OR COUNTY)
_HMOPOP    1   7.51997E-07  .00004243862        0.018       0.9859
REGION2    1   0.002657912  0.0005977013        4.447       0.0001
REGION3    1   0.004399766  0.0006335983        6.944       0.0001
REGION4    1    -0.0033927  0.0007738605       -4.384       0.0001
REGION5    1  -0.000961946   0.000551382       -1.745       0.0811
NBEDPOP    1     -0.360860      0.164681       -2.191       0.0285
_NBEDPOP   1      0.038759      0.178087        0.218       0.8277
NW82       1   -0.00258516   0.001083116       -2.387       0.0170
NW83       1    -0.0011848   0.001072983       -1.104       0.2696
NW84       1   -0.00145569   0.001113454       -1.307       0.1912
NW85       1   -0.00275705   0.001074871       -2.565       0.0104
NW86       1   -0.00282959   0.001540357       -1.837       0.0663
WAIVER     1    -0.0068377  0.0008437428       -8.104       0.0001
MANY86     1   -0.00379946   0.001515978       -2.506       0.0122
HERFINDX   1     -0.052807   0.003838012      -13.759       0.0001
EDUC       1   0.003867141  0.0006676731        5.792       0.0001  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS      1      0.206845      0.027366        7.558       0.0001
OUTPPOP    1   -0.00256204  0.0004397554       -5.826       0.0001
MDBED      1     -0.045332   0.002458155      -18.442       0.0001
```

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PPSBEN/PPSGG02: HOSPITAL ADMITS REGS WEIGHT=E001 WAIVER/NON-WAIVER                    14:52 FRIDAY, DECEMBER 30, 1988    2
URBAN

                PARAMETER     STANDARD   T FOR H0:                 VARIABLE
VARIABLE  DF     ESTIMATE        ERROR  PARAMETER=0   PROB > [T[     LABEL

CAPINC     1  -0.00100292 0.0001583529       -6.333      0.0001  MEAN PER CAPITA INCOME (TEBI)
_MDBED     1     0.016692  0.002584871        6.457      0.0001
_BSNSS     1    0.0064488     0.044752        0.144      0.8854
_OUTPPOP   1  0.002098161 0.0007369723        2.847      0.0044
_CAPINC    1 -0.000759408 0.0002622244       -2.896      0.0038
```

```
PPSBEN/PPSGG02: HOSPITAL ADMITS REGS WEIGHT=E001 WAIVER/NON-WAIVER                    14:52 FRIDAY, DECEMBER 30, 1988    4
RURAL

DEP VARIABLE: HSAPEN_A HOSP ADMITS PER ENROLLEE-AGED

                    SUM OF         MEAN
SOURCE     DF      SQUARES       SQUARE        F VALUE        PROB>F

MODEL      37    45209.163     1221.869        226.522        0.0001
ERROR    4274    23054.104     5.394035
C TOTAL  4311    68263.266

    ROOT MSE      2.322506     R-SQUARE         0.6623
    DEP MEAN      0.099210     ADJ R-SQ         0.6594
    C.V.              2341

                  PARAMETER     STANDARD   T FOR H0:                      VARIABLE
VARIABLE  DF       ESTIMATE        ERROR  PARAMETER=0   PROB > [T[          LABEL

INTERCEP   1       0.212837  0.004394454       48.433       0.0001  INTERCEPT
D82        1    0.006468328  0.002872252        2.252       0.0244
D83        1    0.004777505  0.002723428        1.754       0.0795
D84        1    -0.00998115  0.002967368       -3.364       0.0008
D85        1    -0.00688146   0.00326526       -2.107       0.0351
D86        1    -0.00215123  0.007008051       -0.307       0.7589
SPRING     1    -0.00433222 0.0004816094       -8.995       0.0001
SUMMER     1    -0.00879312 0.0004816094      -18.258       0.0001
AUTUMN     1      -0.010523 0.0005143293      -20.460       0.0001
Q486DUM    1    -0.00447493  0.001037114       -4.315       0.0001
BENPOP     1   -0.000112508 .00008613618       -1.306       0.1916
HBEDPOP    1       2.360057     0.227004       10.397       0.0001
_HBEDPOP   1      -1.398092     0.323726       -4.319       0.0001
HMOPOP     1   0.0003850777 .00007294644        5.279       0.0001  % OF POP ENR IN HMO (SMSA OR COUNTY)
_HMOPOP    1   .00000976947 .00009490399        0.103       0.9180
REGION2    1       0.017545  0.000756421       23.195       0.0001
REGION3    1    0.009574168 0.0006565809       14.582       0.0001
REGION4    1    0.001019143 0.0006475564        1.574       0.1156
REGION5    1    -0.00460735 0.0008340384       -5.524       0.0001
NBEDPOP    1       0.100659     0.125316        0.803       0.4219
_NBEDPOP   1      -0.193561     0.125477       -1.543       0.1230
NW82       1    0.002435106  0.002827997        0.861       0.3892
NW83       1    -0.00238975  0.002788657       -0.857       0.3915
NW84       1    -0.00230333  0.002790451       -0.825       0.4092
NW85       1    -0.00418025  0.002814835       -1.485       0.1376
NW86       1    0.008320749  0.006082967        1.368       0.1714
WAIVER     1    -0.00509272  0.002041613       -2.494       0.0127
MANY86     1    0.007465436  0.006094303        1.225       0.2206
HERFINDX   1     -0.0096235  0.003801247       -2.532       0.0114
EDUC       1    -0.00904007 0.0004172755      -21.665       0.0001  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS      1       0.169051     0.066081        2.558       0.0106
OUTPPOP    1    0.002943586 0.0006363407        4.626       0.0001
MDBED      1      -0.083019  0.004006125      -20.723       0.0001
```

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PPSBEN/PPSGG02: HOSPITAL ADMITS REGS WEIGHT=E001 WAIVER/NON-WAIVER                     14:52 FRIDAY, DECEMBER 30, 1988    5
RURAL

                 PARAMETER      STANDARD    T FOR H0:                 VARIABLE
VARIABLE  DF      ESTIMATE         ERROR  PARAMETER=0   PROB > [T[      LABEL

CAPINC     1 0.0005775703 0.0001986475        2.908      0.0037  MEAN PER CAPITA INCOME (TEBI)
_MDBED     1     0.011301  0.004145708        2.726      0.0064
_BSNSS     1    -0.314829     0.111188       -2.832      0.0047
_OUTPPOP   1  0.006476811  0.001038886        6.234      0.0001
_CAPINC    1 -0.000957645 0.0003379459       -2.834      0.0046
```

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                         CONTENTS OF AGGPRCHG DATASET                       8
                                                  11:27 Friday, March 3, 1989

del: MODEL2
p Variable: A8286

                           Analysis of Variance

                        Sum of         Mean
    Source      DF     Squares       Square      F Value       Prob>F

    Model       15     5.72697      0.38180       47.613       0.0001
    Error     1108     8.88483      0.00802
    C Total   1123    14.61180

        Root MSE       0.08955     R-Square       0.3919
        Dep Mean      -0.20560     Adj R-Sq       0.3837
        C.V.         -43.55375

                           Parameter Estimates

                    Parameter       Standard     T for H0:
riable      DF       Estimate          Error    Parameter=0     Prob > |T|

TERCEP       1      -0.179986     0.04510137         -3.991         0.0001
YPE          1      -0.015079     0.00882402         -1.709         0.0878
PINC         1      -0.007831     0.00213684         -3.665         0.0003
NSS          1      -0.117055     0.48922920         -0.239         0.8109
OPOP         1      -0.000254     0.00010560         -2.408         0.0162
BPOP         1      -0.005369     0.00093476         -5.743         0.0001
TRPOP        1      -0.004730     0.00595681         -0.794         0.4273
D            1       0.003032     0.00253971          1.194         0.2328
ORATE        1      -0.000961     0.00015582         -6.170         0.0001
POP          1      -0.005584     0.00586136         -0.953         0.3410
ECPCT        1       0.118528     0.03213889          3.688         0.0002
CRATE        1       0.203458     0.04863520          4.183         0.0001
R1           1       0.131109     0.00758680         17.281         0.0001
R2           1       0.064310     0.00763525          8.423         0.0001
R3           1       0.054911     0.00757285          7.251         0.0001
MIT82        1      -8.171433     1.08763996         -7.513         0.0001
```

```
Model: MODEL3
Dep Variable: A8286

                              Analysis of Variance

                               Sum of          Mean
     Source        DF         Squares        Square       F Value       Prob>F

     Model         15         6.17656       0.41177        54.088       0.0001
     Error       1108         8.43524       0.00761
     C Total     1123        14.61180

        Root MSE              0.08725      R-Square        0.4227
        Dep Mean             -0.20560      Adj R-Sq        0.4149
        C.V.                -42.43749

                              Parameter Estimates

                          Parameter         Standard      T for H0:
Variable      DF           Estimate            Error     Parameter=0        Prob > |T|

INTERCEP       1          -0.210305       0.04373334          -4.809            0.0001
BTYPE          1          -0.014764       0.00857388          -1.722            0.0854
CAPINC         1          -0.008459       0.00206803          -4.090            0.0001
BSNSS          1          -0.424639       0.36035197          -1.178            0.2389
HMOPOP         1          -0.000396       0.00010411          -3.806            0.0001
NHBPOP         1          -0.005586       0.00089354          -6.251            0.0001
OUTPPOP        1          -0.006422       0.00574622          -1.118            0.2640
BEDPOP         1           0.002472       0.00186527           1.325            0.1853
PRORATE        1          -0.001274       0.00015670          -8.129            0.0001
MDCHARGG       1           0.000852       0.00010995           7.747            0.0001
 ECPCT         1           0.118811       0.03056664           3.887            0.0001
OCCRATE        1           0.202828       0.04728229           4.290            0.0001
QTR1           1           0.130420       0.00738645          17.657            0.0001
QTR2           1           0.063218       0.00742480           8.514            0.0001
QTR3           1           0.054394       0.00737542           7.375            0.0001
ADMIT82        1          -7.097703       0.95449982          -7.436            0.0001
```

SELECTING TRACERS
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PHC AND GEOGRAPHIC EFFECTS
READMISSIONS AND TRANSFERS
RISK ADJUSTED MORTALITY

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Model: MODEL4
Dep Variable: A8285

                          Analysis of Variance

                          Sum of          Mean
     Source      DF      Squares        Square      F Value       Prob>F

     Model       15      3.34863       0.22324       22.830       0.0001
     Error     1108     10.83433       0.00978
     C Total   1123     14.18296

         Root MSE        0.09889     R-Square       0.2361
         Dep Mean       -0.16244     Adj R-Sq       0.2258
         C.V.          -60.87565

                          Parameter Estimates

                        Parameter        Standard     T for H0:
Variable     DF          Estimate           Error    Parameter=0     Prob > |T|

INTERCEP      1         -0.109927      0.04980423         -2.207         0.0275
BTYPE         1         -0.008117      0.00974413         -0.833         0.4050
CAPINC        1         -0.007004      0.00235965         -2.968         0.0031
BSNSS         1         -0.456175      0.54024261         -0.844         0.3986
HMOPOP        1      -0.000000426      0.00011661         -0.004         0.9971
NHBPOP        1         -0.003628      0.00103223         -3.515         0.0005
OUTPPOP       1         -0.003369      0.00657795         -0.512         0.6086
B[illegible]OP         1         -0.002006      0.00280453         -0.715         0.4747
PRORATE       1          0.000106      0.00017207          0.614         0.5396
MDPOP         1         -0.001252      0.00647254         -0.193         0.8467
SPECPCT       1          0.140277      0.03549011          3.953         0.0001
OCCRATE       1          0.065185      0.05370654          1.214         0.2251
QTR1          1          0.073788      0.00837789          8.808         0.0001
QTR2          1         -0.020416      0.00843140         -2.421         0.0156
QTR3          1         -0.014499      0.00836249         -1.734         0.0832
ADMIT82       1         -4.987084      1.20105147         -4.152         0.0001
```

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PPSBEN/PPSBOB09: BEAAQTR: FOR 1ST QTR OF 1982-1986 DATA ONLY                          14:29 WEDNESDAY, DECEMBER 28, 1988    1

DEP VARIABLE: AD86     HOSP ADMITS PER ENROLLEE-AGED FOR 1986

                      SUM OF         MEAN
SOURCE      DF       SQUARES       SQUARE      F VALUE      PROB>F

MODEL       12      0.026734  0.002227822       14.076      0.0001
ERROR      289      0.045740 0.0001582682
C TOTAL    301      0.072473

     ROOT MSE       0.012580     R-SQUARE       0.3689
     DEP MEAN       0.088487     ADJ R-SQ       0.3427
     C.V.           14.21736

                   PARAMETER      STANDARD   T FOR H0:                  VARIABLE
VARIABLE   DF       ESTIMATE         ERROR  PARAMETER=0  PROB > !T!       LABEL

INTERCEP    1       0.116123      0.017405        6.672      0.0001 INTERCEPT
PRORTE86    1 .00005728544 .00005003953          1.145      0.2532 VALUE OF PRORATE IN 1986 1ST QTR
HBEDPOP     1       1.674229      0.510452        3.280      0.0012
HMOPOP      1 0.0000186634 0.0001492855          0.125      0.9006 % OF POP ENR IN HMO (SMSA OR COUNTY)
MDBED       1      -0.061044   0.009626113       -6.341      0.0001
BENPOP      1 -0.000472513 0.0003430801         -1.377      0.1695
URBAN       1  -0.00240163    0.00222884       -1.078      0.2821
NBEDPOP     1      -0.564685      0.271071       -2.083      0.0381
HERFINDX    1      -0.034720      0.013618       -2.550      0.0113
EDUC        1 0.0007393576   0.001627766        0.454      0.6500 MEDIAN SCHOOL COMPLETED IN 1970
BSNSS       1       0.024922      0.103641        0.240      0.8101
OUTPPOP     1  -0.00295615   0.001448808       -2.040      0.0422
CAPINC      1  -0.00112939 0.0006830807         -1.653      0.0993 MEAN PER CAPITA INCOME (TEBI)
```

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PPSBEN/P[illegible]0B09: BEAAQTR: FOR 1ST QTR OF 1982-1986 DATA ONLY                       14:29 WEDNESDAY, DECEMBER 28, 1988    5

DEP VARIABLE: AD86     HOSP ADMITS PER ENROLLEE-AGED FOR 1986

                      SUM OF         MEAN
SOURCE      DF       SQUARES       SQUARE       F VALUE       PROB>F

MODEL       12      0.029206  0.002433835        16.257       0.0001
ERROR      289      0.043267  0.000149714
C TOTAL    301      0.072473

    ROOT MSE        0.012236     R-SQUARE        0.4030
    DEP MEAN        0.088487     ADJ R-SQ        0.3782
    C.V.            13.82781

                   PARAMETER      STANDARD    T FOR H0:                   VARIABLE
VARIABLE    DF      ESTIMATE         ERROR  PARAMETER=0   PROB > !T!        LABEL

INTERCEP     1      0.133384      0.016736        7.970       0.0001  INTERCEPT
PRORTE85     1  -0.000179661 .00004246699       -4.231       0.0001  VALUE OF PRORATE IN 1985 1ST QTR
HBEDPOP      1      1.556268      0.495524        3.141       0.0019
HMOPOP       1 .00001711057 0.0001443692        0.119       0.9057  % OF POP ENR IN HMO (SMSA OR COUNTY)
MDBED        1     -0.060315   0.009288045       -6.494       0.0001
BENPOP       1  -0.000693284 0.0003348748       -2.070       0.0393
URBAN        1   -0.00159185   0.002140443       -0.744       0.4577
NBEDPOP      1     -0.429279      0.262736       -1.634       0.1034
HERFINDX     1     -0.036908      0.013229       -2.790       0.0056
EDUC         1   0.000171798   0.001577109        0.109       0.9133  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS        1   -0.00714547      0.101089       -0.071       0.9437
OUTPPOP      1   -0.00352631   0.001415946       -2.490       0.0133
CAPINC       1   -0.00124565 0.0006647451       -1.874       0.0620  MEAN PER CAPITA INCOME (TEBI)
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SELECTING TRACERS
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PPSBEN/[illegible]B0B09: BEAAQTR: FOR 1ST QTR OF 1982-1986 DATA ONLY                        14:29 WEDNESDAY, DECEMBER 28, 1988   17

DEP VARIABLE: AD86     HOSP ADMITS PER ENROLLEE-AGED FOR 1986

                    SUM OF          MEAN
SOURCE      DF     SQUARES        SQUARE        F VALUE        PROB>F

MODEL       13    0.051630    0.00397152         54.875        0.0001
ERROR      288    0.020844 .00007237364
C TOTAL    301    0.072473

    ROOT MSE    0.00850727      R-SQUARE         0.7124
    DEP MEAN      0.088487      ADJ R-SQ         0.6994
    C.V.           9.61418

                 PARAMETER      STANDARD    T FOR H0:                  VARIABLE
VARIABLE   DF     ESTIMATE         ERROR  PARAMETER=0    PROB > !T!      LABEL

INTERCEP    1    -0.010051      0.013594       -0.739        0.4603  INTERCEPT
PRORTE86    1 -.0000965739 .00003484018        -2.772        0.0059  VALUE OF PRORATE IN 1986 1ST QTR
AD85        1     0.817965      0.044102       18.547        0.0001  HOSP ADMITS PER ENRULLEE-AGED FOR 1985
HBEDPOP     1     0.479665      0.351140        1.366        0.1730
HMOPOP      1 -.0000212796  0.000100974        -0.211        0.8332  % OF POP ENR IN HMO (SMSA OR COUNTY)
MDBED       1    -0.023548  0.006816157        -3.455        0.0006
BENPOP      1  0.000266579  0.000235398         1.132        0.2584
URBAN       1  0.002125983  0.001526846         1.392        0.1649
NBEDPOP     1    -0.609658      0.183322       -3.326        0.0010
HERFINDX    1  -0.00425039  0.009354212        -0.454        0.6499
EDUC        1  0.002662057  0.001105613         2.408        0.0167  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS       1     0.081771      0.070152        1.166        0.2447
OUTPPOP     1 0.0006910477 0.0009992653         0.692        0.4898
CAPINC      1 -0.000274157 0.0004642144        -0.591        0.5553  MEAN PER CAPITA INCOME (TEBI)
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PPSBEN/PPSBOB9A: BEAAQTR: FOR 1ST QTR OF 1982-1986 DATA ONLY                          10:19 THURSDAY, DECEMBER 29, 1988    1

DEP VARIABLE: DIFF8685 AD86-AD85

                     SUM OF         MEAN
SOURCE     DF       SQUARES       SQUARE       F VALUE       PROB>F

MODEL      12   0.008898075 0.0007415062        12.180       0.0001
ERROR     289      0.017593 .00006087667
C TOTAL   301      0.026491

    ROOT MSE     0.00780235     R-SQUARE        0.3359
    DEP MEAN    -0.00425591     ADJ R-SQ        0.3083
    C.V.            -183.33

                  PARAMETER     STANDARD    T FOR H0:                   VARIABLE
VARIABLE   DF      ESTIMATE        ERROR  PARAMETER=0   PROB > !T!       LABEL

INTERCEP    1     -0.030460     0.010672       -2.854       0.0046  INTERCEPT
PRORTE85    1   -0.00025891 .00002707981       -9.561       0.0001  VALUE OF PRORATE IN 1985 1ST QTR
HBEDPOP     1      0.199370     0.315980        0.631       0.5286
HMOPOP      1  .00003771626 .00009205951        0.410       0.6823  % OF POP ENR IN HMO (SMSA OR COUNTY)
MDBED       1   -0.00849065  0.005922683       -1.434       0.1528
BENPOP      1  0.0002556902 0.0002135387        1.197       0.2321
URBAN       1   0.002742546  0.001364891        2.009       0.0454
NBEDPOP     1     -0.564107     0.167538       -3.367       0.0009
HERFINDX    1   0.002498753  0.008436015        0.296       0.7673
EDUC        1   0.002992012  0.001005671        2.975       0.0032  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS       1      0.028886     0.064461        0.448       0.6544
OUTPPOP     1  0.0005915681 0.0009029027        0.655       0.5129
CAPINC      1  -0.000206988 0.0004238862       -0.488       0.6257  MEAN PER CAPITA INCOME (TEBI)
```

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PPSBEN/F   B09: BEAAQTR: FOR 1ST QTR OF 1982-1986 DATA ONLY                                  14:29 WEDNESDAY, DECEMBER 28, 1988   15

DEP VARIABLE: DIFF8682 AD86-AD82

                    SUM OF         MEAN
SOURCE      DF     SQUARES       SQUARE       F VALUE       PROB>F

MODEL       12    0.014228  0.001185639        10.213       0.0001
ERROR      289    0.033551 0.0001160946
C TOTAL    301    0.047779

    ROOT MSE      0.010775     R-SQUARE        0.2978
    DEP MEAN     -0.015142     ADJ R-SQ        0.2686
    C.V.          -71.1595

                 PARAMETER     STANDARD    T FOR H0:                   VARIABLE
VARIABLE   DF     ESTIMATE        ERROR  PARAMETER=0   PROB > !T!       LABEL

INTERCEP    1    -0.043506     0.014737       -2.952       0.0034  INTERCEPT
PRORTE85    1 -0.000254898 0.0000373961       -6.816       0.0001  VALUE OF PRORATE IN 1985 1ST OTR
HBEDPOP     1    -0.315004     0.436355       -0.722       0.4709
HMOPOP      1 .00001938158 0.0001271304        0.152       0.8789  % OF POP ENR IN HMO (SMSA OR COUNTY)
MDBED       1     0.023200  0.008178978        2.837       0.0049
BENPOP      1 0.0001901535 0.0002948881        0.645       0.5195
URBAN       1  0.004946679  0.001884857        2.624       0.0091
NBEDPOP     1    -0.569829     0.231363       -2.463       0.0144
HERFINDX    1  -0.00863566     0.011650       -0.741       0.4591
EDUC        1  0.003532388  0.001388789        2.544       0.0115  MEDIAN SCHOOL COMPLETED IN 1970
BSNSS       1  -0.00374863     0.089018       -0.042       0.9664
OUTPPOP     1 0.0008805428  0.001246871        0.706       0.4806
CAPINC      1  -0.00114374 0.0005853693       -1.954       0.0517  MEAN PER CAPITA INCOME (TEBI)
```

SELECTING TRACERS

PHC SYNTHESIS

PHC AND GEOGRAPHIC EFFECTS

READMISSIONS AND TRANSFERS

RISK ADJUSTED MORTALITY

Abt Associates Inc.
55 Wheeler Street, Cambridge, Massachusetts 02138-1168
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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--
POSTHOSPITAL CARE AND PPS: A SYNTHESIS

Working Paper

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ABSTRACT

This paper summarizes the research to date on the trends in Medicare posthospital care (PHC) services and the role of PPS in altering those trends. Most available research focuses on the 1981-86 periods and is incapable of separating PPS effects from the strong trends in general home health and non hospital service use that characterize this period. Data also drawn mainly from large samples of beneficiary claims, and statistical work based on data defined on episodes surrounding hospitalization. One study uses the area-quarter as the unit of analysis, while others utilize the person level episode data for tracer conditions that include stroke, hip replacement, and pneumonia cases.

The research evidence summarized here examines the trends in use of PHC, the relationship of use to PPS, geographic differences in PHC use, the costs of PHC, the evidence on severity at discharge, and the evidence on PHC episode content. The research findings can be summarized as follows:

- There have been significant positive trends throughout the 1981-86 period in Medicare beneficiary use of services in the 30 day period following hospital discharge; including HHA admissions and visits, SNF admissions, use of DME, and use of ambulatory medical care services. Days of SNF care, on the other hand, are falling.

- Statistical results suggest that the introduction of PPS has been associated with these trends. The evidence is also consistent with the view that the increases in use are the result of more intensive, earlier application of these servies following discharge in the post PPS period.

- Rural areas are shown to have more significant increases in use of services than urban areas, essentially causing a general convergence in use rates of PHC services. There is evidence that rural beneficiaries travelling to urban hospitals are disadvantaged in accessing PHC services.

- Payments for PHC services are rising rapidly, but are still dominated by rehospitalization costs. The payments for the 30 day post period represent about 19% of total episode costs in 1986 (from pre 30 to post 30 days), up from 15% in 1981. HHA service costs and DME are clearly the most rapidly inflating PHC cost elements.

- There is evidence that increases in PHC service use and costs are related to measurable increases in severity and functional disabiltiy of Medicare patients at the point of hospital discharge.

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Posthospital Care and PPS: A Synthesis

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1.0 INTRODUCTION

During the 1980s several factors may have contributed to a more intensive utilization of posthospital care by Medicare beneficiaries. For the most part, these have been policies designed to discourage excessive use of hospital inpatient services. Increases in posthospital care (PHC) may, therefore, be the result of a substitution away from these services. More liberal treatment by Medicare of home and hospice benefits have also contributed to a more intensive utilization of PHC services. The more important recent changes that are likely to have affected the consumption of posthospital services are as follows.

- The relatively fixed payment per case under the PPS, implemented in late 1983, makes long lengths of stay and intensive utilization of inpatient care unprofitable for the hospital. This may have induced substitutions of posthospital services for hospital inpatient care.

- The regulatory oversight provided by PROs and begun in late 1983 may have induced physicians to reduce the use of hospital services. Increases in home health (HHA), care in a skilled nursing facility (SNF) and other posthospital services may have resulted.

- In 1981 the Medicare HHA benefit was liberalized. This change sparked a rapid growth in the supply and use of these services which may also have extended to posthospital care.

- In 1983 Medicare adopted a hospice benefit for terminally ill persons, which required delivery of previously non-covered services and discourages use of expensive inpatient services in favor of palliative care at home. This change could also have contributed to a general increase in physician comfort levels with home based care.

- Changes in the private insurance sector, though for the most part not directly affecting Medicare, may have altered physician and hospital behavior so as to cause a general shift away from hospital inpatient care. These changes include the growth in payment safeguards (pre-authorization and utilization review) against overpayment for inpatient services and the growth in capitated or competitive plans (among Medicare beneficiaries as well as in general) which also place downward pressures on inpatient utilization.

This paper synthesizes the results from several studies recently undertaken for HCFA by Abt Associates. Each of these studies, from one perspective or another, addresses changes in posthospital care that have occurred during the 1980s. The period of analysis for all of these studies is roughly 1981-1986. Data is taken from Medicare bill and payment record files. Some of the studies are purely descriptive, focusing on trends in the utilization of various posthospital services and in the characteristics of the Medicare populations consuming these services. Other studies are statistically more rigorous and rely on econometric techniques to isolate the effects of the PPS and other factors on the utilization of posthospital care. Some studies are broad, covering a wide range of services, while other focus on one or two types of care. These studies not only investigate the levels of posthospital care and their incidence among Medicare discharges, but also their timing.

1.1 Published Literature

To date, few published studies have investigated Medicare utilization of posthospital services during the period surrounding the implementation of the PPS. Of these, the approaches have for the most part been descriptive and little attempt has been made to statistically isolate the effects on these services of the PPS and other factors. While the following studies do not always separate posthospital use from the more general use of SNF, HHA and other services, their findings nevertheless shed some light on how the utilization of posthospital care has changed in recent years. Table 1 summarizes the findings from this literature.

The only large study of general Medicare utilization showed mixed evidence about the effects of PPS on nonhospital service use. Gutterman and Dobson (1986) reported Medicare program statistics on the utilization of SNF, HHA, physician and hospital outpatient services for the pre-TEFRA period through the first year of the PPS. When measured in real terms, annual rates of increase for SNF and HHA services for the first PPS year (1983-84), exceeded those for the pre-TEFRA period (1973-82). However, they were lower than those for the TEFRA year (1982-83). Annual rates of increase for outpatient hospital and physician services were markedly lower for the first PPS year than for the pre-TEFRA period.

Two descriptive studies point to higher HHA admission rates post discharge. DesHarnais et al. (1987) looked at the destination of Medicare patients upon discharge from the hospital. Discharges to SNF, HHA and rehospitalization were investigated (as well as discharges to the home and discharged dead). Posthospital utilization of these services was gauged by the proportion of cases discharged to each of these settings.

Table 1

Summary of Previous Studies of PPS Effects on PHC Services

	Post Hospital Use			General Service Use		
	HHA	SNF	Other	HHA	SNF	Other
Gutterman and Dobson (1986)				Visits Higher than pre-TEFRA	Days Higher than pre-TEFRA	MD/OPD visits lower than pre-TEFRA
DesHarnais (1987)	Admits Higher	Admits NS	Rehosp-NS			
Long (1987)	Admits Higher	Admits Higher				
Lewis (1987)					Admits higher	
Lyles (1988)					Admits higher and days lower	
Fisher (1988)						Physician Office Use Higher
Weinberger (1988)			Use of Clinic, ER Re-hosp are higher			
Neu & Harrison (1988)	Admits & visits higher	Admits higher and days lower				

NS = Not significant
Blank = Not studied

Actual proportions for the first PPS year were compared to predicted values extrapolated from 1980-83 trends. While the actual proportions for SNF, HHA and rehospitalization were all greater than the predicted proportions, the difference was statistically significant for HHA only. A similar study was undertaken by Long et al. (1987). The principal difference between this and the preceding study is that some attempt was made to hold constant the effects of casemix on discharge destination. Findings show that changes in the proportions of cases discharged to SNF and HHA were positive and considerably larger in the first PPS year than in the preceding years (1980-83). No tests for statistical significance were made.

Two studies of general SNF utilization patterns pre/post PPS suggest that PPS may have increased SNF admissions but lowered lengths of stay. Lewis et al. (1987) focused on changes in the composition of SNF admissions under the PPS. Three data samples, all from southern California, were compared. These included two pre-PPS samples (1980 and 1982-83) and one for the first PPS year (1984). Findings showed a very dramatic increase during the first PPS year in the proportion of admissions that were Medicare beneficiaries. Another study, by Lyles (1988), investigated the impact of the PPS on nursing home utilization in Oregon. The nursing home data analyzed included mostly intermediate care facilities (ICFs) as well as SNFs. Changes that occurred during 1982-83 were compared to those that occurred during 1983-84. The percentage change in total admissions was considerably greater during the 1983-84 period while the percentage change in total patient days was considerably lower.

Two studies of services other than SNFs and HHS suggest that PPS may have increased the use of ambulatory and other services. Fisher (1987) compared the pre (1982) and post PPS (1985) distributions of physician charges among the various health care settings. Results showed that physician inpatient charges declined significantly as a percentage of the total while those in other settings increased. A study by Weinberger et al. (1988) focused on a single diagnosis, diabetes mellitus. Hospital and posthospital utilization were compared for two cohorts of patients, one pre PPS (1981) and the other post PPS (1983-84). Results showed more clinic visits, emergency room visits and hospital readmissions among the post PPS cohort.

Of the earlier studies of posthospital care under the PPS, that performed by the Rand Corporation is by far the most thorough (see Neu and Harrison, 1988). This study is based on 1981 and 1984-85 samples of Medicare beneficiaries. Posthospital utilization of SNF and HHA services is compared between the two periods. SNF services were directly linked to the hospital stay (i.e. that qualifying beneficiaries for Medicare coverage) while the HHA services linked to the stay varied depending on how the episode was defined (i.e.

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a 60-day posthospital period or a 190-day period). Also, to limit the effects of changes in the composition of hospital admissions between 1981 and 1984-85, the posthospital utilization of the above services was also observed separately for selected DRGs. Changes in the DRG composition of the Medicare hospital population seem to account for most of the change in posthospital care between the two periods. When comparing posthospital utilization for specific DRGs, the proportions of cases using SNF or HHA services were generally higher. Findings also reveal little relationship between SNF and HHA utilization (as either substitutes or complements) and a wide variation in the posthospital utilization of these services among the states.

2.0 SYNTHESIS OF RECENT STUDIES FOR HCFA

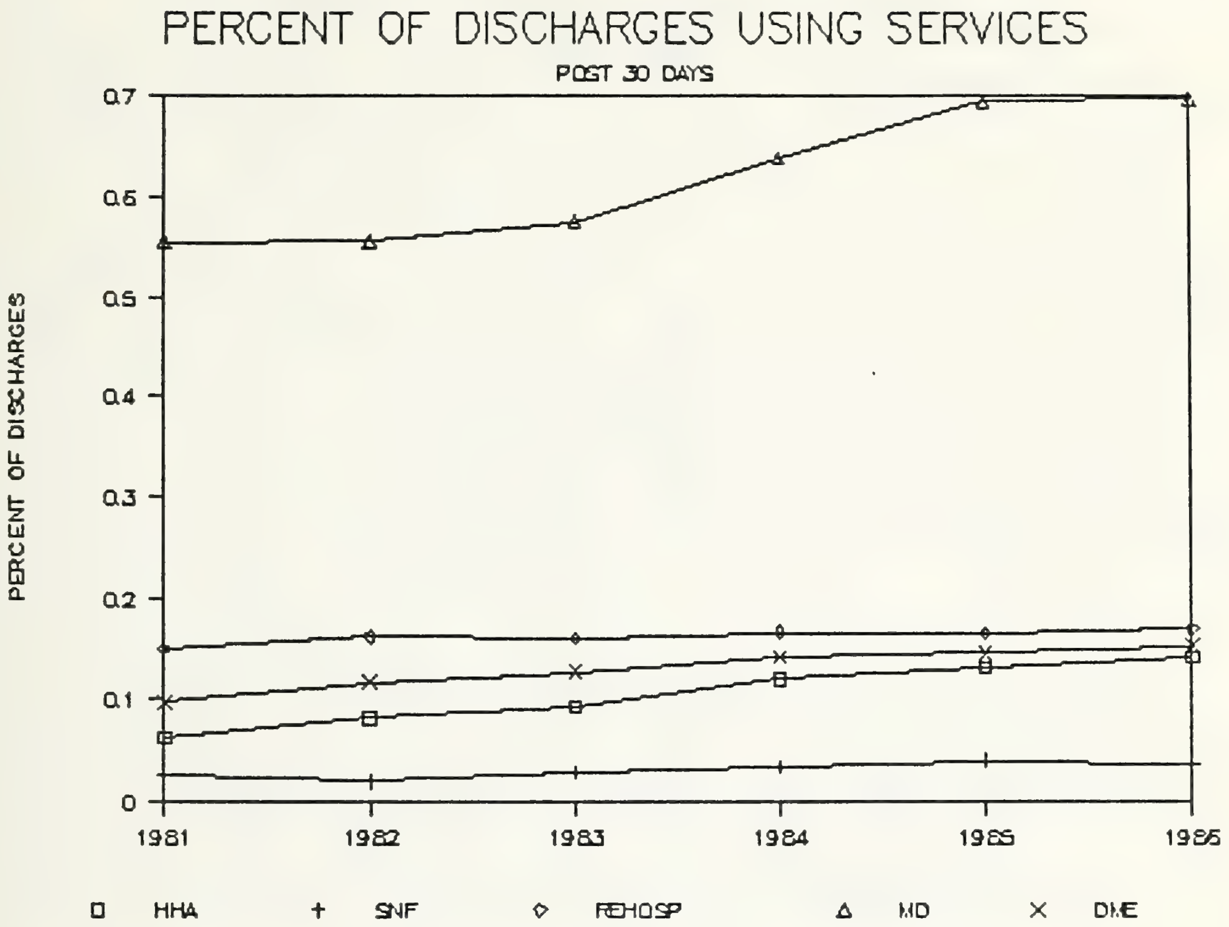
The following sections discuss more recent, and yet unpublished findings on how Medicare utilization of posthospital services has changed during the 1980s. In particular we focus on the effects of the PPS which may have induced a substitution of posthospital services for inpatient hospital care. We also report findings relating to geographic influences on the utilization of these services. As noted, changes in the timing as well as the volume of posthospital consumption were investigated and both are discussed here. The emphasis is on home health (HHA) and SNF services since these were viewed as the most likely types of posthospital care to have been affected by the PPS. Other forms of posthospital care also investigated are physician services, durable medical equipment (DME) use and clinic and emergency room visits.

Trends in PHC Utilization

Medicare hospital discharges are increasingly likely to be receiving covered services in the 30-day period post discharge. As Figure 1 indicates, the likelihood of use of all types of Medicare covered services has risen over the 1981 to 1986 period. The increase has been most precipitous for HHA services (up from 6% of all discharges in 1981 to 14% by 1986). The fraction of discharges using DME is also up by about 50% (from 10% to over 15%). More modest increases are evident for physicians, SNFs and rehospitalization.

Most of the trend in PHC use results from rapid increases in the fraction of discharges using Part A services with one week (7 days) of discharge. As shown in Figure 2, 15% of all Medicare discharges were receiving HHA or SNF services within a week of discharge in 1986; up from less than seven percent in 1981. Most of this improvement in PHC access is due to sharp increases in HHA use. The second panel of Figure 2 illustrates the pattern of initiation of HHA services over the period surrounding episodes

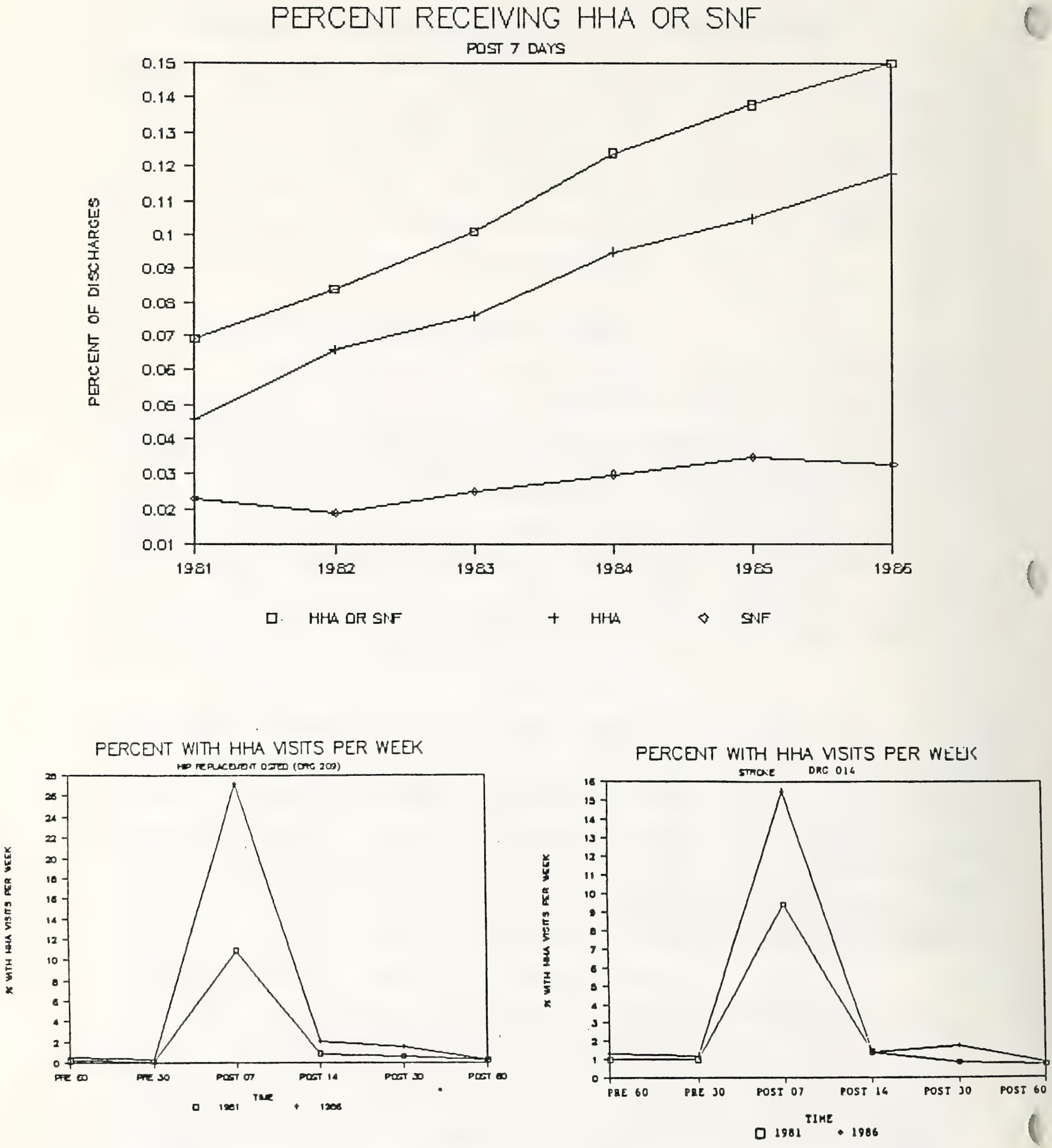
Figure 1



Percent of Discharges Using Services Post 30 Days

	1981	1982	1983	1984	1985	1986
HHA	0.063	0.082	0.094	0.121	0.133	0.143
SNF	0.026	0.021	0.029	0.034	0.040	0.038
REHOSP	0.151	0.163	0.161	0.167	0.166	0.170
MD	0.554	0.555	0.575	0.638	0.694	0.697
DME	0.098	0.118	0.128	0.143	0.147	0.154

Figure 2



PERCENT RECEIVING HHA OR SNF

POST 7 DAYS

PERCENT WITH HHA VISITS PER WEEK

HIP REPLACEMENT OSTEO (DRG 209)

PERCENT WITH HHA VISITS PER WEEK

STROKE DRG 014

of hospitalizations for hip replacements and strokes. These figures emphasize the sharp contrast in the use of HHA services in the first posthospital week--and the absence of significant changes over time in use at other points in the episode (shown here to be the period from 60 days before admission to 60 days following discharge). Similar patterns are seen for hip fractures, pneumonia, and hernia discharges (Gaumer and Fama, 1988).

While access has improved, service intensity of SNF and HHA within the 30-day post discharge period has not increased apace. Figure 3 shows that HHA visits per user within 30 days of discharge have increased by more than 20%: from about 8.5 visits in 1981 to about 10.5 visits by 1986. Thus, the average Medicare discharge now has over 1.5 HHA visits within 30 days of discharge, up from about 0.5 visits only five years prior.[1] SNF days per user, on the other hand, have actually fallen from about 19.5 to about 15 days within the first 30 days of discharge. Overall, the average Medicare discharge receives only slightly more days of SNF service in the 30 days post discharge (up from about 0.5 days in 1981 to about 0.6 days in 1986).

PHC use of HHA services has been expanding faster than general use of HHA services in the Medicare program. Figure 4 shows the quarterly trend in HHA use per enrollee. Over the period HHA use has increased from about .2 visits to over .3 visits per enrollee per quarter. PHC use (e.g., within 30 days of discharge) has risen from .06 visits to about .12 visits per enrollee per quarter. As indicated in the bottom panel, the ratio of PHC to all HHA visits has increased from about a third of the HHA client base to over 39% in 1986.

PPS Effects on PHC Use

Observed trends in the use of posthospital care may in part be explained by incentives created by the PPS. Three studies have attempted, using econometric techniques, to statistically isolate the effects of the PPS on posthospital care. Table 2 summarizes the findings of this research. In general, the research shows to the extent that statistically significant results were estimated, they suggest that the volume of HHA and SNF care in the period after hospital discharge has increased as a result of PPS and that a greater fraction of PHC has come to be delivered in the immediate post-discharge period since the inception of PPS. The only exception to this general summary is for post-hospital SNF care. One study has found evidence that SNF care has declined in urban areas as a result of PPS.

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[1] Computed as the product of the fraction getting HHA services and the number of visits per user.

Figure 3

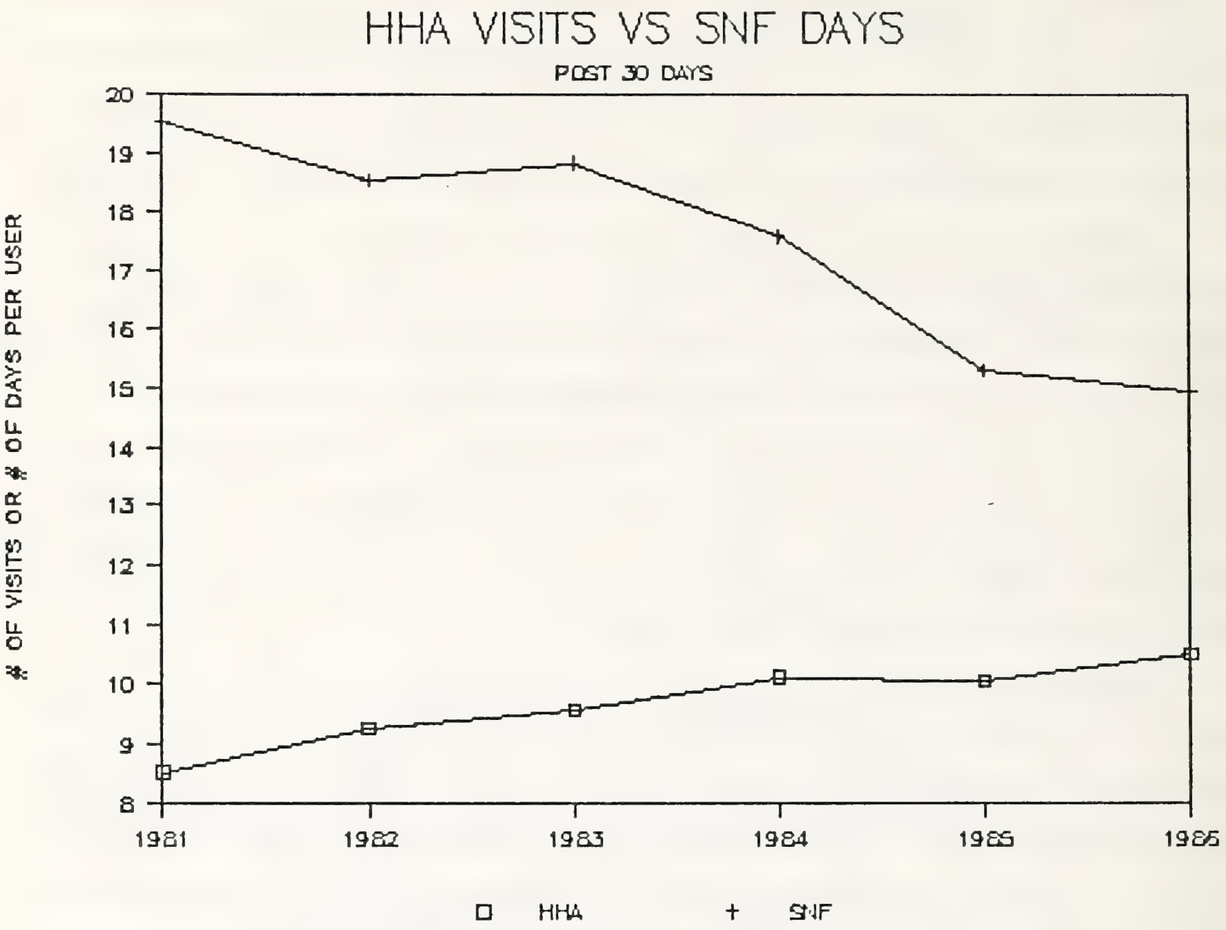
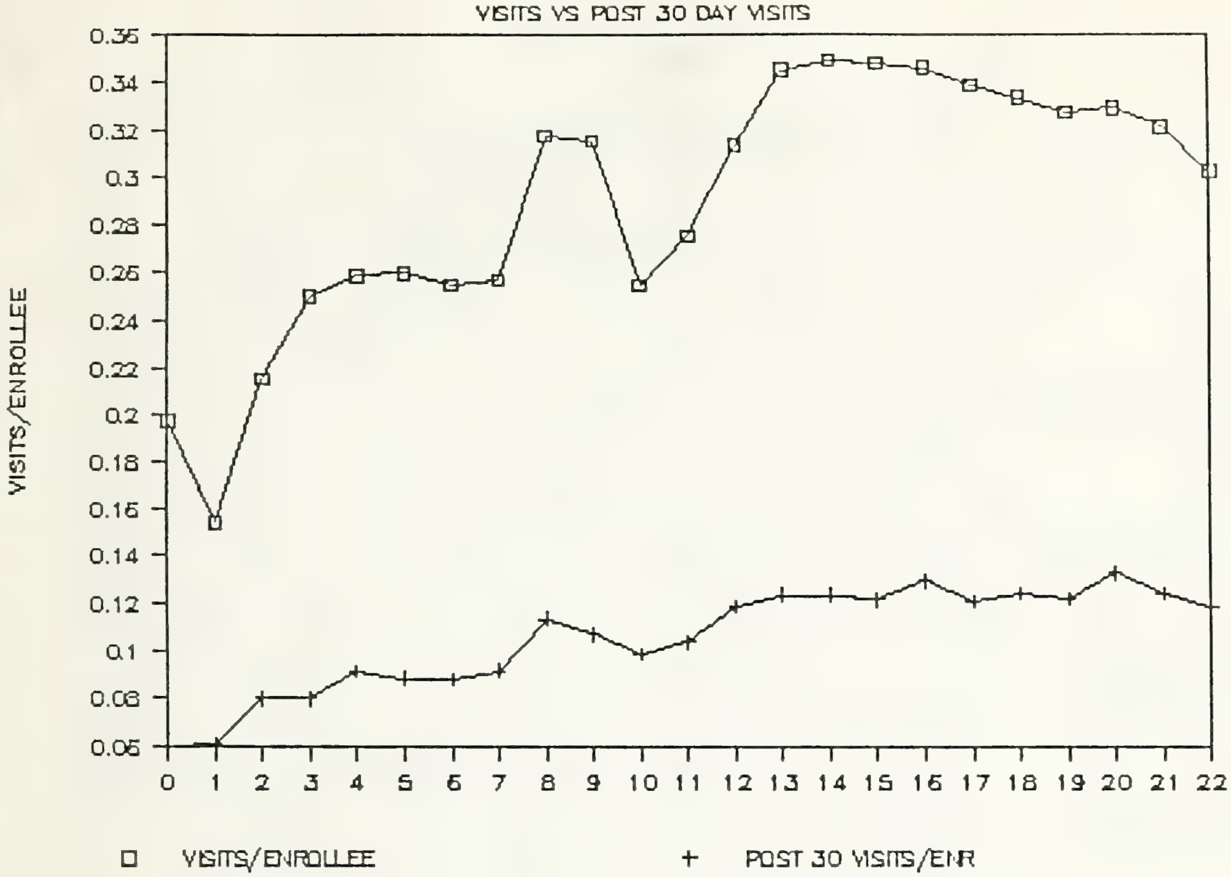

HHA VISITS VS SNF DAYS
POST 30 DAYS
# OF VISITS OR # OF DAYS PER USER
20
19
18
17
16
15
14
13
12
11
10
9
8
1981
1982
1983
1984
1985
1986
□ HHA
+ SNF

Figure 4

HHA VISITS PER ENROLLEE: 1981–1986



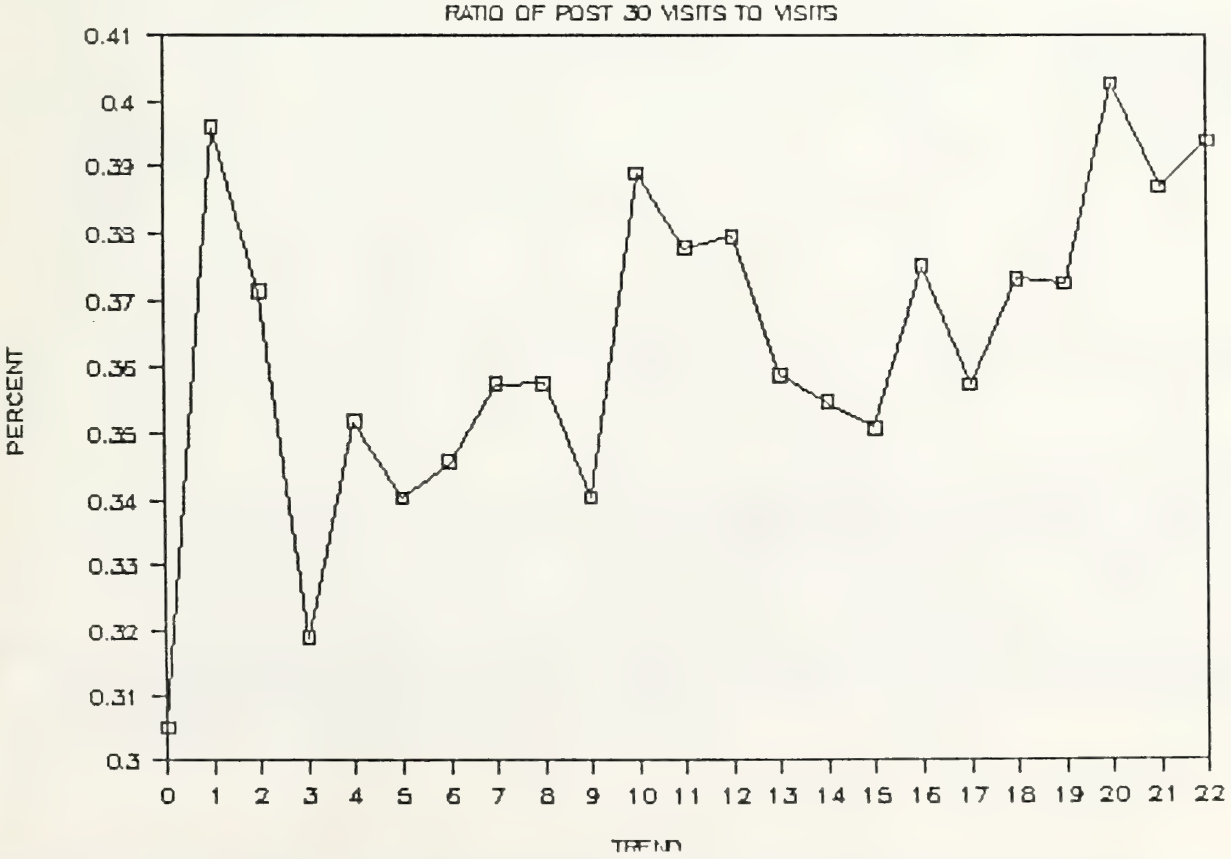


Table 2

Summary of Research on PPS Effects on Medicare PHC Service Use

	Per Capita Analysis	Tracer Studies Stroke	Hip Fracture	Hip Arthritis	Pneumonia
HHA Use					
Fraction of Hospital Stays Followed by HHA	+	NS	NS	NS	NS
PHC Intensity	+	N	N	+	N
PHC Timing	NS	N	+	+	+
General SNF Use					
Fraction of Hospital Stays Followed by SNF	+/-*	NS	NS	NS	NS
PHC Intensity	+/-*	+	+	N	N
PHC Timing	NS	+	+	+	+
PHC DME					
Intensity	NS	N	N	+	+
Timing	NS	N	N	N	+
PHC Physicians					
Intensity	NS	+	+	+	N
Timing	NS	+	N	+	N

+ Evidence indicates higher utilization post PPS

- Evidence indicates lower utilization post PPS

N No significant or ambiguous findings

NS Not studied

* The Per Capita Analysis found positive effects for rural areas and zero or negative effects for urban areas.

Investigating both the volume and timing of posthospital services during the post 60-day period, Gianfrancesco (1988) found significant PPS effects for HHA, SNF and physician services. For HHA services, only the timing of consumption[2] seems to have been affected. Both timing and volume were affected for SNF and physician's services. HHA use was measured in visits per discharge, SNF in days per discharge and physician services in adjusted charges per discharge.[2] Significant results almost always showed higher levels of posthospital care for beneficiaries discharged from hospitals that were more dependent on Medicare.[3] These beneficiaries also consumed services sooner after discharge. The financial impact of the PPS on each hospital seems also to have influenced the utilization of posthospital care. In a number of instances, beneficiaries discharged from hospitals that stood to gain more under the PPS had lower levels of posthospital care and consumed these services less quickly after discharge. Other types of posthospital care such as DME, clinic and emergency room use showed fewer PPS effects among the diagnostic groups studied and many of these effects were in a direction opposite to what had been anticipated. Significant results in the hypothesized direction were most often observed for stroke cases.

In another study Schmitz (1988) analyzed the effects of the PPS on HHA and SNF use per capita and also posthospital use (30 days) at the area level. The influence of PPS was gauged in two ways. The first was a set of indicator variables for year inserted into utilization equations estimated on a sample consisting of nonwaiver states only (a regression variation of the simple "pre- post" estimator). PPS effects were inferred from the magnitudes and statistical significance of coefficients of indicator variables for 1984 through 1986 compared to the years 1981 through 1983. In some specifications the interaction of these year indicators with the ratio of Medicare enrollees to the population was added. If the coefficients of the year indicators truly represent PPS effects, then their magnitude would be expected to be greater in areas having a high concentration of enrollees.

The second way of approximating PPS effects was the use of a set of indicator variables for year used together with a second set of year indicators defined specifically for nonwaiver states. Both sets of indicators were used in utilization equations estimated on a sample of waiver and nonwaiver states for the years 1981-1986. This second method is a regression variant of the "double difference" estimator.

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[2] Measured as the fraction of HHA visits in 60 days that were received in the first 30 poast discharge.

[2] Adjusted for inflation and cross-sectional differences in labor costs.

[3] Medicare dependence was assumed to gauge a hospital's susceptibility to the PPS. Such hospitals would be more likely to reduce inpatient services and, thereby, foster higher levels of posthospital consumption.

Schmitz's results indicate positive and statistically significant effects of PPS on SNF care in rural areas. SNF admissions, covered SNF days in the 30-day post hospital period and the fraction of hospital stays followed by SNF admissions all rose in rural areas in 1984. These measures generally declined in 1985 and 1986, though not enough to reverse the 1984 increase. Moreover, the decline after 1984 was significantly slower in PPS states than in waiver states. In all cases in which a statistically significant effect was observed, higher enrollee-to-population ratios were associated with higher rates of growth of post-hospital SNF care in PPS states during the period 1984-1986.

Effects of PPS on urban SNF care are much less clear-cut. While SNF use increased in 1984 in urban areas, subsequent declines in 1985 and 1986 were more than sufficient to cancel out the increase within two years. The rate of decline in 1985 and 1986 was somewhat slower in PPS states than in waiver states, so it is possible that in the absence of PPS, SNF care would have declined still more in those states. Nevertheless, SNF admissions and covered SNF days in the 30-day post discharge period were lower in urban areas of PPS states in 1985 and 1986 than in any of the years 1981 through 1983.

While he was unable to construct clear tests, Schmitz judged the evidence as supporting positive PPS effects on HHA care. Levels of HHA care increased throughout the 1981-1986 period, so attribution of some portion of the increase to PPS is difficult. In urban areas, HHA care (visits in the 30 day post discharge period and the fraction of hospital stays followed by HHA care) grew more slowly in PPS states than in waiver states in 1982 and more rapidly in PPS states in 1983 and after, suggesting that PPS and TEFRA have tended to increase post-hospital use of HHA. In rural areas, the rate of increase in post-hospital HHA care in 1984 and 1985 were generally greater than in prior years, though not dramatically so. Rates of increase in HHA use were higher in rural areas of PPS states than in rural areas of waiver states, though the difference is generally not statistically significant.

The apparent inconsistency between the Schmitz and Gianfrancesco studies in relation to PPS effects on posthospital SNF use are likely explained by differences in the sample used. The Schmitz study includes all Medicare cases while the Gianfrancesco study focuses on subgroups of pneumonia, stroke and hip replacement. In addition, Gianfrancesco did not perfrom separate analyses for urban and rural areas. Schmitz's combined urban/rural analyses indicated an overall rise in post-hospital SNF care after implementation of PPS.

In a third study Stavins and Gaumer (1988), investigating beneficiary health service use in the last 90 days of life, found significant and positive PPS effects for HHA and physician non-inpatient services. These were measured in inflation adjusted Medicare reimbursements per discharge. The influence of the PPS was gauged by a binary variable indicating whether the service was received in a non-waivered state and during a PPS year. While these services were not explicitly linked to hospital stays, any effects of the PPS logically could have occurred only through a substitution for inpatient hospital care. However, the study does not distinguish between services provided before and after a hospital stay.

Together the studies do provide substantial evidence that the utilization of posthospital care was altered by the PPS. There is also evidence that these effects varied considerably among different diagnostic groups and types of posthospital care. the service most affected seems to have been HHA, though it is unclear whether this effect was mostly on timing rather than level.

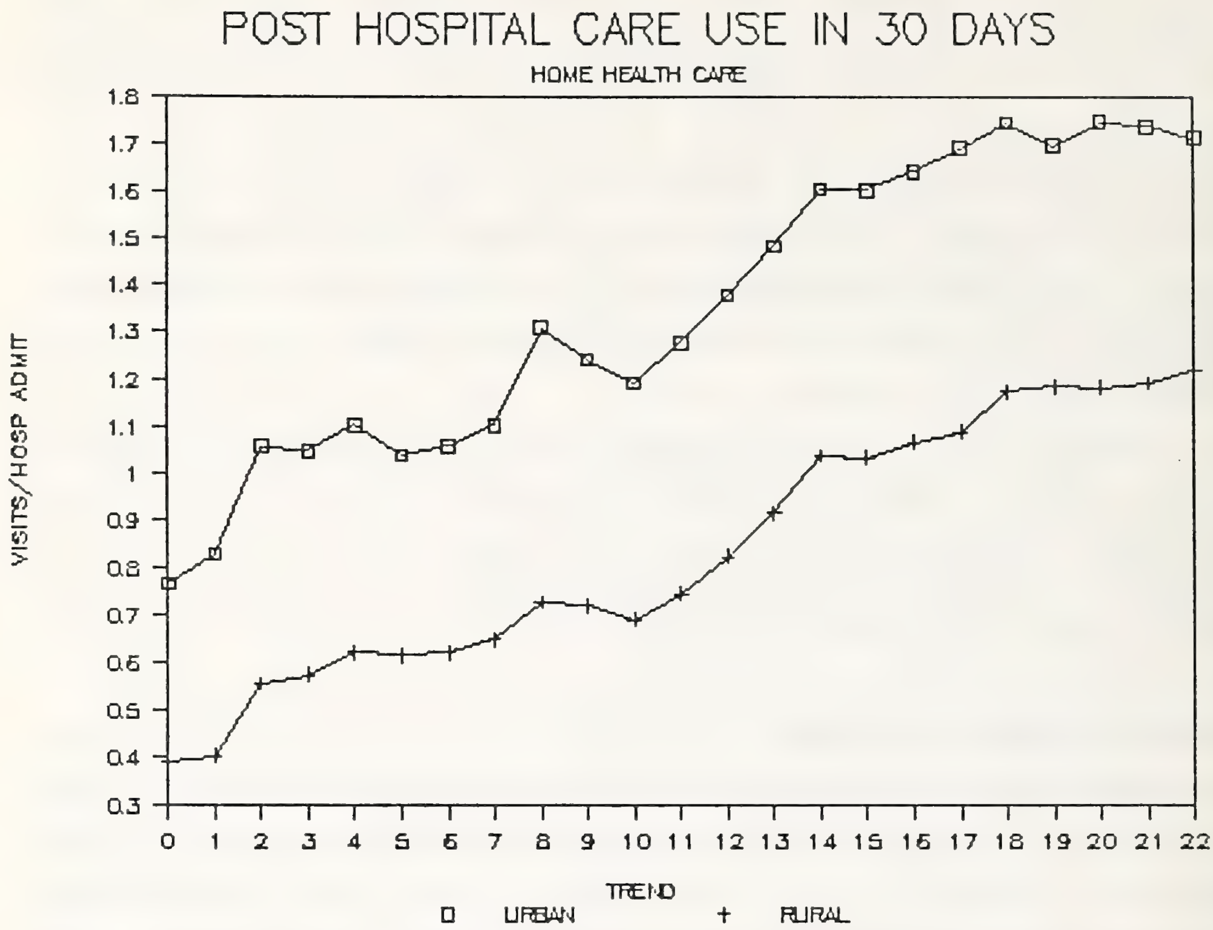
Geographic Differences in PHC Use

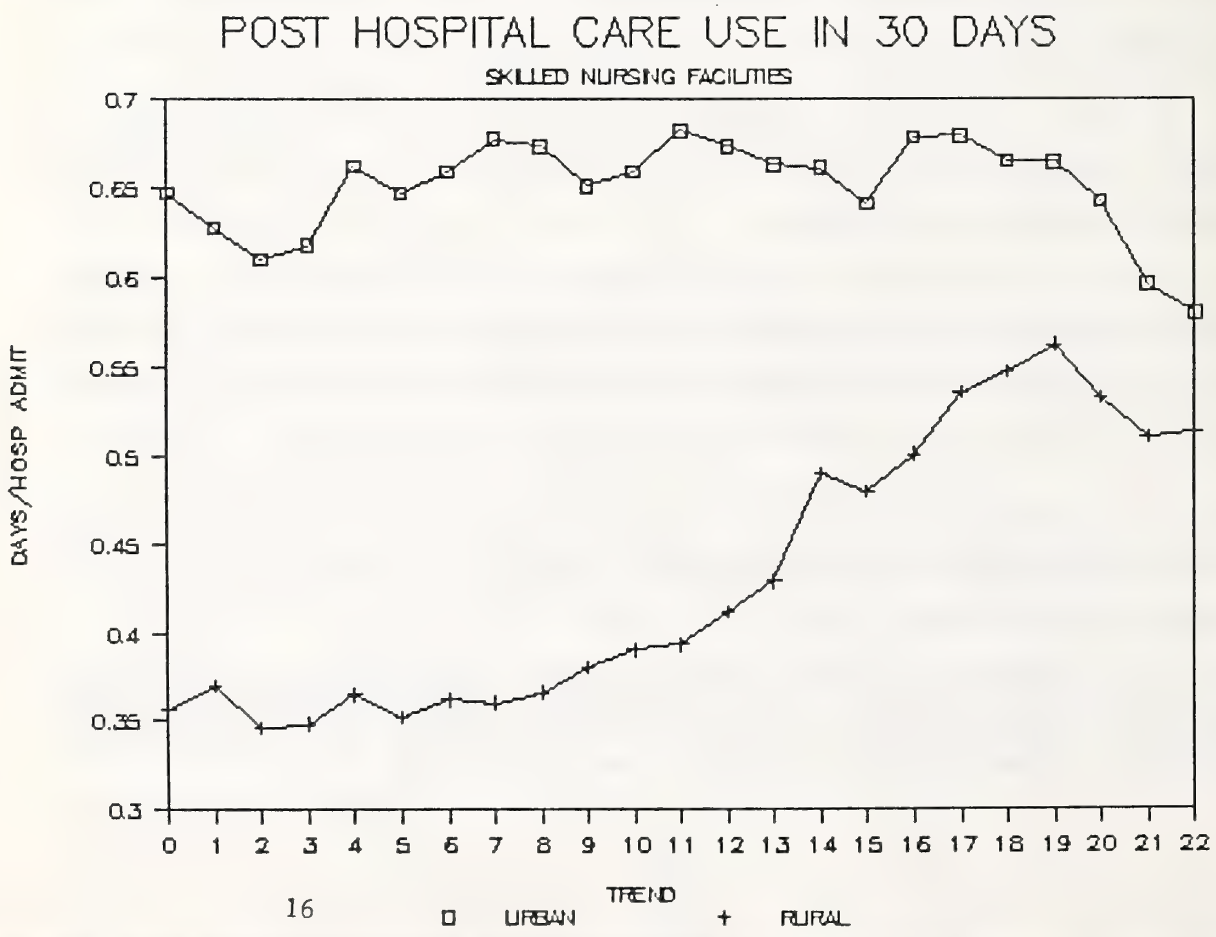
There have been large disparities in use of PHC across urban (SMSA) and rural (non-SMSA) areas. For home health, Figure 5 shows that visits within 30 days of discharge (per discharge) are up in both types of areas, though a substantial gap remains. In 1986, urban beneficiary discharges used about 1.7 HHA visits within 30 days of discharge, while rural counterparts used only about 1.2 visits. For SNFs, days per admit have increased markedly in rural areas, nearly closing the gap enjoyed by the urban areas. By 1986, urban beneficiary discharges used an average of slightly less than 0.6 SNF days within the month following discharge while rural counterparts used about 10% less SNF care over the same interval.

Gaumer and Fama, in their descriptive analysis of health service utilization during beneficiary episodes, found differences in posthospital use among rural and urban beneficiaries. Specifically, they looked at the proportions of rural and urban discharges using HHA or SNF services within the first seven days after discharge. Observations were made for ten diagnostic subgroups created from the four tracers (pneumonia, stroke, hernia and hip replacement). With one exception (hernia) results indicate higher levels of posthospital use for urban beneficiaries. However, 1981-86 trends show that the urban/rural gap was shrinking.

This study also looked at the subgroup of rural beneficiaries who were discharged from urban hospitals. Case study work had suggested that these persons may

Figure 5


POST HOSPITAL CARE USE IN 30 DAYS
HOME HEALTH CARE
VISITS/HOSP ADMIT
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
TREND
□ URBAN
+ RURAL


POST HOSPITAL CARE USE IN 30 DAYS
SKILLED NURSING FACILITIES
DAYS/HOSP ADMIT
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
TREND
□ URBAN
+ RURAL

have less access to post hospital care in view of logistical difficulties of discharge planners to engage HHA services or SNF placements in less familiar areas. As described in Table 3, the likelihood of getting SNF or HHA care within seven days favors urban beneficiaries who receive care in urban hospitals. The table shows, however, that there does not seem to be any substantial PHC access problem for this "vulnerable" group of discharges. The only indication across the noted travers where these persons seem noticeably disadvantaged is for the osteoarthrosis hip replacements. The regression models in the Gianfrancesco study confer that the rural/urban group is not disadvantaged. Using a measure that gauges the geographic divergence between the beneficiary's county of residence and that of the discharging hospital, indicates that rural residents traveling to more urban areas for their hospital care suffer no disadvantages in accessing posthospital care.

The Gianfrancesco study contains the most rigorous analysis of geographic effects patterns of PHC. Beneficiary geographic location is categorized using a county classification developed by the Appalachian Regional Commission. Values range from 1 to 10, where 1 indicates a central metropolitan county and 10, the most isolated class of rural county. For the descriptive analysis beneficiary data were divided into three groups based on this county classification: remote rural (8-10), near rural (6-7), and urban (1-5).[5] Considerable differences in PHC use were observed across the geographic groups. For all of the diagnostic groups studied, levels of posthospital SNF use declines with ruralness of beneficiary residence. Figure 6 describes these patterns for stroke cases. Trends over the 1981-86 period, however, suggest that this gap may be closing. Posthospital HHA services showed similar patterns among the geographic areas. Posthospital physician services, while lower for rural beneficiaries, showed no differences between remote rural and near rural. Trends for these services also revealed a narrowing of the gap between rural and urban levels. Posthospital DME usage showed considerably fewer differences among the geographic areas, especially in later years.

Schmitz included a set of regional indicators variables in his models. Overall, post-hospital SNF care was found to be highest in the far west and lowest in the mid-centrl sections of the country. Post-hospital HHA care was highest in the southeast and lowest in the far west. By contrast, hospital days per enrollee during the period were highest in the northeast and lowest in the far west.

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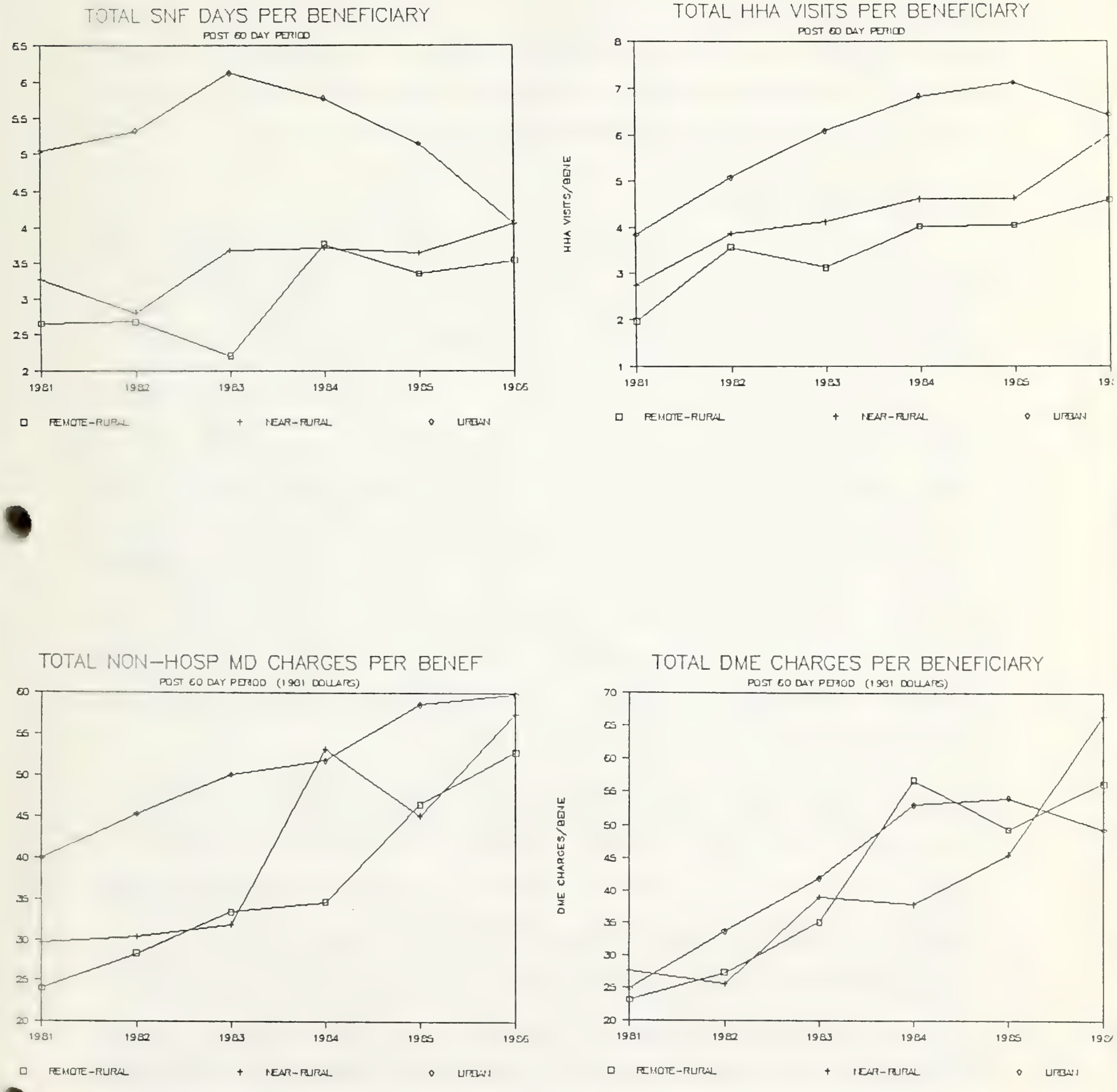
[5] These correspond to the definitions used by HCFA. Remote rural and near rural are simply a disaggregation of HCFA rural.

Table 3

Percent Receiving HHA or SNF Services
Within 7 Days of Discharge

	Beneficiary Location/Hospital Location		
	Rural/Rural	Urban/Urban	Rural/Urban
Stroke			
1981	12.2	24.2	17.8
1986	27.4	29.1	24.9
Increase	125%	20%	41%
Hip (Arth)			
1981	12.2	18.5	11.5
1986	36.9	39.6	26.1
Increase	202%	114%	127%
Hip (Fx)			
1981	22.0	43.3	35.2
1986	46.8	56.2	49.8
Increase	113%	30%	41%
Pneumonia (89,90)			
1981	5.1	8.0	5.3
1986	11.8	16.3	12.6
Increase	131%	104%	138%

Figure 6


TOTAL SNF DAYS PER BENEFICIARY
POST 60 DAY PERIOD
SNF DAYS/BENE
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1981
1982
1983
1984
1985
1986
□ REMOTE-RURAL
+ NEAR-RURAL
◇ URBAN
TOTAL HHA VISITS PER BENEFICIARY
POST 60 DAY PERIOD
HHA VISITS/BENE
8
7
6
5
4
3
2
1
1981
1982
1983
1984
1985
19
□ REMOTE-RURAL
+ NEAR-RURAL
◇ URBAN
TOTAL NON-HOSP MD CHARGES PER BENEF
POST 60 DAY PERIOD (1981 DOLLARS)
NON-HOSP MD CHARGES/BENE
60
55
50
45
40
35
30
25
20
1981
1982
1983
1984
1985
1986
□ REMOTE-RURAL
+ NEAR-RURAL
◇ URBAN
TOTAL DME CHARGES PER BENEFICIARY
POST 60 DAY PERIOD (1981 DOLLARS)
DME CHARGES/BENE
70
65
60
55
50
45
40
35
30
25
20
1981
1982
1983
1984
1985
19
□ REMOTE-RURAL
+ NEAR-RURAL
◇ URBAN

The Gianfrancesco study also attempted to determine if the effect of the PPS on posthospital care varied across different geographic areas. The regression models were applied to the data disaggregated according to the three geographic groups described earlier: remote rural, near rural and urban. Findings, which are based on an analysis of HHA and SNF services only, indicate that the PPS had the strongest (positive) impact on the utilization of posthospital care by urban beneficiaries. The weakest impact was observed among beneficiaries in the near rural group.

Other Influences on PHC Use

Medicare PHC consumption during the 1980s has been affected by factors other than the PPS and geographic location. The regression results from the Gianfrancesco and Schmitz studies reveal several other influences on both the level and timing of posthospital services. The more important among these are summarized as follows.

The Gianfrancesco study, which is at the beneficiary level and covers several types of posthospital care, found a number of patterns for the four tracer subgroups studied. The models include measures of pre-hospital PHC use for each beneficiary.[7] These were assumed to capture variations in case severity among the beneficiaries within each subgroup. Invariably, significant positive relationships were observed between the pre-hospital consumption of services and PHC use. Another interesting finding relating to these variables is the universally strong relationship between pre and posthospital use for a particular type of care. For example, beneficiaries consuming relatively large quantities of HHA prior to hospitalization, other things held constant, also consumed relatively large amounts after discharge. This suggests that individuals develop patterns of health care use and tend to stick to these patterns.

General supply constraints for each type of service were also specified in the regression models. These were per capita amounts of each service measured at the state or BEAA level. Almost always, a positive relationship was observed between the use of a posthospital service and its general availability. Also noteworthy, the posthospital consumption of some services was often negatively related to the supply of other services. For example, posthospital SNF use was observed to bear a negative relationship with supplies of hospital beds and HHA services, implying that they are substitutes.

Other findings from the study show that the use of PHC was often negatively related to the scope of services offered by the discharging hospital. This makes sense and was as expected. A broader scope of services may reflect a greater ability to meet the health care needs of the patient and, therefore, a lesser need for posthospital care. A conflicting finding is the relative absence of this relationship for hospital teaching status. (Perhaps the two variables are highly correlated.) Another interesting finding is the frequent observance of a significant positive relationship between the for-profit status of the discharging hospital and the level of PHC use. Beneficiaries discharged from high occupancy hospitals also tended to have higher levels of PHC use. While the underlying reasons for both of these findings are unclear, we suspect that they may relate to the discharging hospital's financial incentives to substitute posthospital care for inpatient services. A positive relationship was also often observed for hospital size. Here, size may be correlated with the severity of discharges. Other interesting findings are that the effects of age varied depending on service and diagnostic group, men generally consumed more posthospital care than women (when looking at total Medicare reimbursements for PHC), and race seemed to have lettle effect other than on the types of PHC more frequently used.

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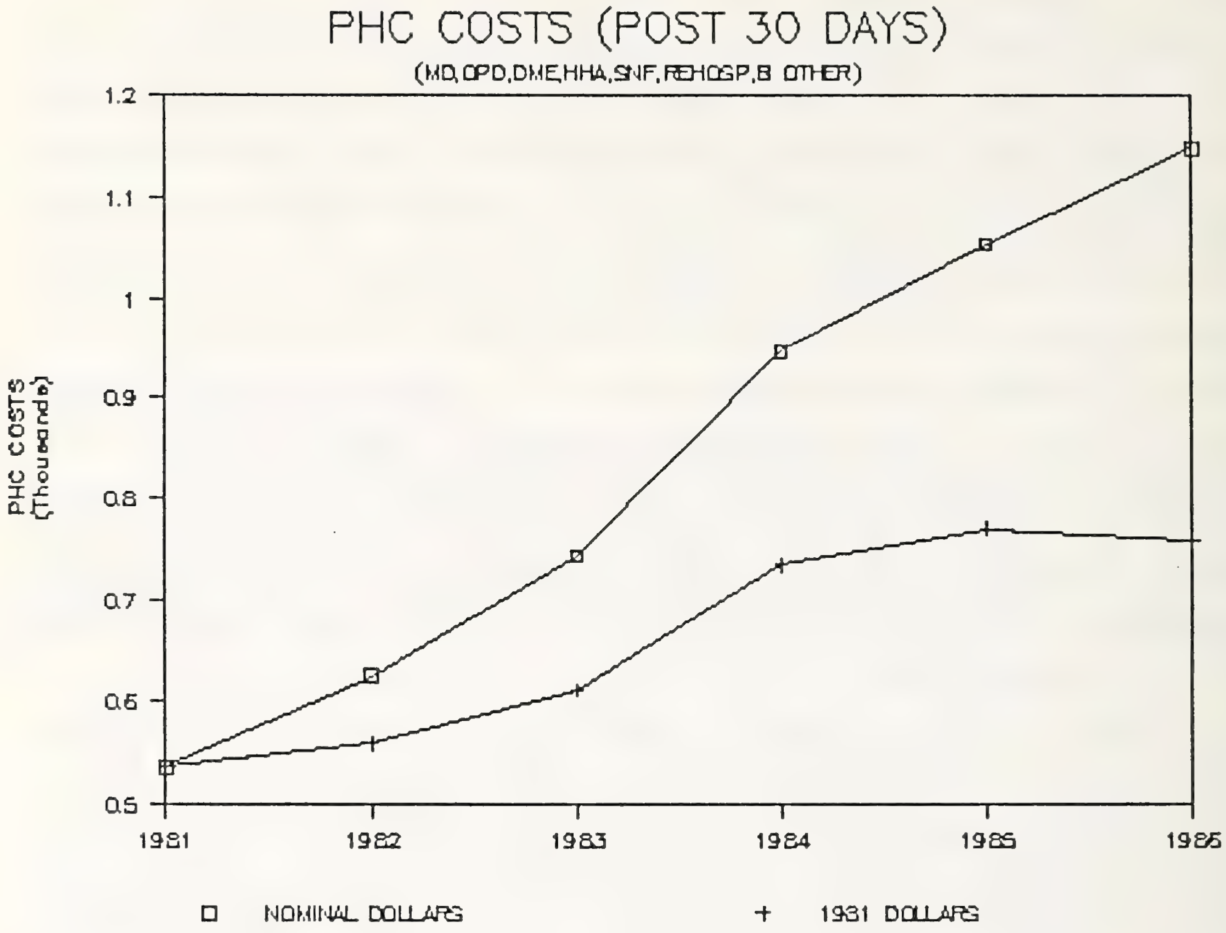
[7] These were adjusted for inter-area supply differences.

This area level study (Schmitz, 1988) of PHC use focused on HHA and SNF services only. The regression models for this study also included an array of general supply variables. These variables frequently proved significant, often showing the negative relationships indicative of substitutions among services (e.g., between hospital beds and the number of SNF days used in the post 30-day period). While the models in the Schmitz study include considerably fewer explanatory variables than those in the Gianfrancesco study (primarily because of measurement at the more aggregate level), certain measures are unique to the former. For example, the Schmitz models specified seasonal variables. Results for these showed a significantly higher level of posthospital HHA use during winter. The results for posthospital SNF approached significance and revealed a similar pattern. This finding may simply reflect the increased incidence of respiratory infections and fractures among the elderly during winter months.

The Costs of PHC

Medicare payments for services to patients following discharge are increasing. Figure 7 shows this trend. In 1981 Medicare hospital discharges consumed $536 of services in the 30-day period following discharge; doubling by 1981 to $1148 (or $758 if deflated to 1981 dollars using the DRI/Medical Care price index). The post period spending is rising more rapidly than total episode reimbursements; post spending represents a growing fraction of total episode reimbursements; up from 15% of total episode Medicare payments in 1981 to nearly 19% by 1986.

Figure 7



POST HOSPITAL CARE COSTS
(Post 30 Days)

	1981	1982	1983	1984	1985	1986
NOMINAL	535.73	625.33	743.34	946.49	1052.88	1148.19
CONSTANT	535.73	559.09	611.36	734.30	770.26	758.06

PHC includes: MD, OPD, DME, HHA, SNF, PART B OTHER, READMIT, REHOSP

ALL DATA FROM RANDOM DISCHARGE FILE

Post hospital payments are dominated by rehospitalization, which continues to represent about 75% of the payments for services rendered within 30 days of discharge. As Table 4 indicates, components of PHC payments are increasing faster than the DRI inflation index. While payments for covered services except hospitals are relatively small (2-6% of post payments), several (HHA, DME, and other Part B) are consuming increasing shares of PHC dollars. Home health payments are increasing faster than any other component of PHC; HHA spending in the 30-day post discharge period has risen from $19 per discharge in 1981 to about $73 by 1986 ($48 in 1981 dollars). During the five-year period, HHA spending has jumped from the 6th (out of 7) most important Medicare spending category for PHC to second (behind rehospitalization).

There are substantial variations in post hospital payments across different types of discharges. Rand's work (Neu and Harrison, 1988) shows that PHC spending on SNF, HHA and rehabilitation services is concentrated across DRGs. For SNF care, about 68 percent of all Medicare SNF outlays are represented by only 23 DRGs. For HHA spending, about 52 percent of outlays are consumed by the top 23 DRGs; the authors also report that the concentration is increased between 1981 and 1984/85.

Table 4 also shows wide differences in PHC spending levels per DRG. Across the selected tracers the 30-day post discharge payments in 1986 (1981 dollars) range from less than $100 (inguinal hernia repair) to over $825 (hip fracture repairs within DRG 209).

Are Hospital Discharges Sicker?

There is evidence that persons discharged from hospitals are sicker and more functionally disabled than in the past. The most incisive Abt study dealing with this issue is that by Noether. This study relies on measures of severity rather than indirect indicators such as posthospital mortality and readmission. Severity at point of admission and at point of discharge was measured for a sample of several hundred Medicare patients in a few selected hospitals. These patients fell into three tracers: pneumonia, stroke and hip replacement. The sample was taken in two parts, one consisting of 1982 discharges (pre-PPS) and the other of 1985 discharges (post-PPS). Severity measures are based on a methodology (Medical Illness Severity Grouping Systems) developed by MediQual Systems, Inc. and consist of a discrete ranking ranging from 0 to 4. Descriptive statistics based on the three tracers reveal a general increase in severity at admission and little or no change at discharge between 1982 and 1985. The increased severity at admission is consistent with the decline in admission rates during the period and the tendency not to hospitalize less serious cases. The absence of significant change

Table 4

Costs of Post Hospital Care in 30 Days Post Discharge
(1981 Dollars)

All Discharges	1981		1986*	
Average Episode Payment**	3475.57		4025.08	
Post Payments (% of episode)	535.73	(15.4)	758.06	(18.8)
• Physician Office Post 30 (% of post)	21.41	(4.0)	29.23	(3.9)
• OPD Post 30 (% of post)	35.22	(6.6)	37.45	(4.9)
• DME Post 30 (% of post)	8.66	(1.6)	15.39	(2.0)
• HHA Post 30 (% of post)	19.12	(3.6)	47.96	(6.3)
• SNF Post 30 (% of post)	27.44	(5.1)	30.79	(4.1)
• Rehosp. and Readmit Post 30 (% of post)	402.34	(75.1)	562.84	(74.2)
• Other B Post 30 (% of post)	21.54	(4.0)	34.40	(4.5)
Tracer Discharges				
Pneumonia (DRG 89,90) Post Payments (%)	305.50	(9.5)	333.43	(10.8)
Stroke (DRG 014) Post Payments (%)	530.78	(12.5)	702.86	(16.2)
Hip Repair (Fractures) Post Payments (%)	628.16	(8.9)	825.56	(11.3)
Hernia (Unilat) Post Payments (%)	78.38	(3.7)	90.81	(5.3)

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*Nominal dollars for 1986 are 1.5146 times indicated dollar values in this column.
**Episode spans period 30 days pre admission to 30 days post discharge.

in severity at discharge does not support the view that patients are being discharged quicker and sicker under the PPS. This is despite the fact that mean lengths of stay for live discharges declined significantly for all three of the tracers studied and that rehospitalization rates increased significantly for two of the three tracers. The increase in rehospitalization may be explained by factors other than discharge severity.[8]

The Noether study applied regression analysis to the data to hold constant differences between the 1982 and 1985 samples that may have obscured PPS effects on severity at discharge. The major difference is the higher admission severity in 1985 which should have positively influenced discharge severity. Key explanatory variables reflecting a PPS influence on discharge severity are a binary variable (equal to 1 for 1985 cases), length of stay and a measure of intensive/coronary care use during each stay. The latter two variables were expected to bear a negative relationship to discharge severity. To the extent that these services were reduced under the PPS, their significance would suggest a positive impact of the PPS on discharge severity. The 1985 dummy was expected to have a positive sign indicating a more general influence of the PPS on discharge severity. Contrary to expectation, the measures of inpatient intensity were positively related to discharge severity where significant, indicating that their correlation with admission severity was obscuring their effects, if any, on discharge severity.[9] The only evidence of a positive PPS impact on severity at discharge was found in the significance of the 1985 dummy for stroke cases.

The regression results from the Noether study are too weak to draw any conclusions regarding the impact of the PPS on discharge severity. There is little evidence that the shorter lengths of stay and other reductions in hospital inpatient care induced by the PPS have generally resulted in patients being discharged quicker and sicker. One interesting finding, however, is the stronger correlation between admission severity and length of stay observed for 1985 in comparison to 1982. This suggests that the shortened lengths of stay reflect increases in efficiency rather than reductions in unnecessary services, which in part explains the absence of a significant negative relationship between length of stay and discharge severity.

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[8] PPS reimbursement provides incentives for rehospitalization, though this is closely monitored by peer review. Also, significant differences were observed between 1982 and 1985 in mortality rates for the 90-day period following discharge. The timing of death during this period, however, seems to have changed but may be explained by the small samples.

[9] This problem could have been avoided if the sample were sufficiently large to enable a disaggregation of cases into groups with similar admission severities.

Content of HHA Episodes

This section reports more detailed findings on how the utilization of HHA services has changed during the 1980s. These services are of special interest to HCFA because of their more liberal treatment under Medicare (beginning in 1981) and because of their potential as substitutes for more costly hospital inpatient and SNF services. Some changes in HHA use patterns are undoubtedly due to increased Medicare coverage while others are explained by the PPS and other pressures that have emerged or intensified during the 1980s. Findings on some of the more important changes are discussed in the following. While these findings relate to the entire HHA episode, they are nevertheless applicable to posthospital care.

Cheh and Williams (1988) studied changes in HHA use during the period 1982-85. The analysis is at the beneficiary level and is based on a sampling of all diagnostic groups using home health care. The more general results show that a compression in HHA episodes seems to have occurred. A higher percentage of all episodes were completed within four months in 1985 as compared to 1982. This trend was disrupted in 1984 when episodes temporarily lengthened. Since 1984 was the first full PPS year, we suspect that this result may be related. Days of HHA care may have been added to substitute for eliminated days of inpatient hospital care. Another finding which seems to contradict a positive PPS influence on HHA use is the uninterrupted decline in the proportion of hospital-discharged HHA cases. However, the decline between 1983 and 1984 is appreciably less than those for 1982-83 and 1984-85. Results also show a higher concentration of HHA visits after 1983, within the first month following discharge from the hospital. This is another indication of a PPS-induced shift to HHA from inpatient hospital care. In general, HHA services were becoming increasingly more concentrated in the first month of the HHA episode after 1983.

Other findings from the Cheh and Williams study pertain to the contents of the HHA episode. A breakdown based on HHA episodes ending in the latter part of the period showed that skilled nursing visits accounted for the largest fraction (42%) of total visits while speech therapy accounted for the smallest (3%). Relatively few beneficiaries received physical, occupational or speech therapy services, but those that did consumed fairly high levels of these.

Regression analysis was also applied to the data to explain within-episode variations in total visits, skilled nursing visits, home health aide visits and total charges. In addition to patient diagnosis, several explanatory variables were specified to reflect beneficiary and home health agency characteristics. Results show that patient diagnosis is generally a poor predictor of home health use. The strongest predictor is hospitalization. Patients who were discharged from a hospital tended to use more skilled nursing services within the first 90 days after discharge, but fewer total services over the course of the episode. Women and minorities also tended to use more services. One of the strongest results is the effect of HHA organizational structure on home health utilization. Proprietary agencies and private non-profits consistently rendered more services than voluntary agencies. Government-operated HHAs provided significantly fewer services. Finally, state licensure and certificate of need laws seem to influence HHA use. Results, however, were unclear as to the specific nature of this influence.

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EVALUATION STUDIES--

EFFECTS OF THE PPS ON THE UTILIZATION OF POSTHOSPITAL CARE

Working Paper

Frank Gianfrancesco

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Effects of the PPS on the Utilization of Posthospital Care

Frank D. Gianfrancesco

Incentives under the Medicare Prospective Payment System (PPS) to economize on hospital inpatient care may have resulted in a more intensive utilization of posthospital care. SNF, home health and services in other settings may have substituted for longer lengths of stay and other inpatient services. The effects of the PPS on several types of posthospital care were analyzed separately for four groups of diagnostically related Medicare discharges. Standard regression analysis was applied to data from thousands of beneficiary episode records for the years 1981-86. The posthospital period for each Medicare beneficiary encompassed the sixty days following discharge from the hospital. PPS effects on both the level and timing of health care services during this period were investigated. The influence of the PPS on posthospital services was measured through its effects on the discharging hospital. Hospitals differed in terms of Medicare dependence and, therefore, vulnerability to the PPS. They also differed in terms of the financial gains (or losses) experienced under PPS. These influences were hypothesized to operate in opposite directions, the former having a positive effect on the level and timing of posthospital services and the latter, a negative effect. The types of posthospital care that appear to have been most affected by the PPS are SNF, home health and physician services. While the PPS was shown to affect total posthospital services for all four diagnostic groups, its net effect was positive for one group only.

1. Introduction

Under the Medicare Prospective Payment System (PPS), hospitals are reimbursed a predetermined amount per Medicare discharge. This departure from cost-based reimbursement gives hospitals a financial incentive to economize on inpatient services. Several studies investigating the effects of the PPS on hospital inpatient utilization have determined that shorter lengths of stay were induced, at least initially. (See Guterman and Dobson, 1986; Feder, Hadley and Zuckerman, 1987; and Gianfrancesco, 1987). Shortened lengths of stay and other reductions in hospital inpatient services may, in turn, have fostered a more intensive utilization of posthospital care. Changes in hospital case mix under the PPS may have also affected the utilization of posthospital services.[1]

The effects of the PPS on posthospital care were estimated by applying standard regression techniques to Medicare beneficiary data. Efforts were made to control for effects on these services of changes in hospital case mix. This was in part achieved by focusing the analysis on specific diagnostic groups. The utilization of posthospital care was analyzed separately for four groups of diagnostically related Medicare discharges: stroke, pneumonia and two hip replacement groups. To further control for changes in hospital case mix, measures of case severity were specified in the regression models. Several other influences on the utilization of posthospital care were also taken into account.

The following types of posthospital care were analyzed at the beneficiary level: care provided in skilled nursing facilities (SNF), home health services (HHA), clinic and emergency room visits, non-inpatient physician services, durable medical equipment (DME) usage, and rehospitalizations. PPS effects on total posthospital care per beneficiary were also estimated. Utilization of the above services was measured over a 60-day posthospital period. PPS effects on both the level and timing of these services were analyzed.

2. Earlier Evidence

Few studies have investigated the effects of the PPS on posthospital care. Most of these provide only indirect evidence in that no attempts were made to link the various health care services to hospital stays. Also, the evidence is essentially descriptive, relying on pre- and post-PPS comparisons. The following is a brief summary of the findings.

Gutterman and Dobson (1986) reported statistics on the utilization of SNF, HHA, physician and hospital outpatient services for the pre-TEFRA period through the first year of the PPS. When measured in real terms, annual rates of increase for SNF and HHA services for the first PPS year (1983-84) exceeded those for the pre-TEFRA period (1973-82). However, they were lower than those for the TEFRA year (1982-83). Annual rates of increase for outpatient hospital and physician services were markedly lower for the first PPS year than for the pre-TEFRA period.

DesHarnais et al. (1987) looked at the destination of Medicare patients upon discharge from the hospital. Discharges to SNF, HHA and rehospitalization were investigated (as well as discharges to the home and discharged dead). Posthospital utilization of these services was gauged by the proportion of cases discharged to each of these settings. Actual proportions for the first PPS year were compared to predicted values extrapolated from 1980-83 trends. While the actual proportions for SNF, HHA and

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rehospitalization were all greater than the predicted proportions, the difference was statistically significant for HHA only.

A similar study was undertaken by Long et al. (1987). The principal difference between this and the preceding study is that some attempt was made to hold constant the effects of case mix on discharge destination. Findings show that changes in the proportions of cases discharged to SNF and HHA were positive and considerably larger in the first PPS year than in the preceding years (1980-83). No tests for statistical significance were made.

Lewis et al. (1987) focused on changes in the composition of SNF admissions under the PPS. Three data samples, all from southern California, were compared. These included two pre-PPS samples (1980 and 1982-83) and one for the first PPS year (1984). Findings show a very dramatic increase during the first PPS year in the proportion of SNF admissions that were Medicare beneficiaries.

Another study, by Lyles (1988), investigated the impact of the PPS on nursing home utilization in Oregon. The nursing home data included mostly intermediate care facilities (ICFs) as well as SNFs. Changes that occurred during 1982-83 were compared to those that occurred during 1983-84. The percentage change in total admissions was considerably greater during the 1983-84 period while the percentage change in total patient days was considerably lower.

Fisher (1987) compared the pre- (1982) and post- (1985) PPS distributions of Physician charges among the various health care settings. Results showed that physician inpatient charges declined significantly as a percentage of the total while those in other settings increased.

A study by Weinberger et al. (1988) focused on a single diagnosis, diabetes mellitus. Hospital and posthospital utilization were compared for two cohorts of patients, one pre PPS (1981) and the other, post PPS (1983/84). Results showed more clinic visits, emergency room visits and hospital readmissions among the post PPS cohort.

Of the earlier studies of posthospital care under the PPS, that performed by The Rand Corporation is by far the more thorough (see Neu and Harrison, 1988). This study is based on 1981 and 1984/85 samples of Medicare beneficiaries. The posthospital utilization of SNF and HHA services was compared between the two periods. SNF services were directly linked to the hospital stay (i.e that qualifying beneficiaries for Medicare coverage) while the HHA services linked to the stay varied depending on how the episode was defined (i.e. a 60-day posthospital period or a 190 day period). Also, to limit the effects of changes in hospital case mix between 1981 and 1984/85, the posthospital utilization of the above services was observed separately for selected DRGs. Changes in the DRG composition of the Medicare hospital population seem to have accounted for most of the changes in posthospital care between the two periods. When comparing posthospital utilization for specific DRGs, the proportions of cases using SNF or HHA services were generally higher under the PPS. However, average SNF days per beneficiary were considerably lower while HHA visits per beneficiary were higher. Findings also reveal little relationship between SNF and HHA utilization (as either substitutes or complements) and a wide variation in the posthospital utilization of these services among the states.

A major limitation of the above studies is that they are essentially discriptive and make no attempt to define and test for a systematic relationship between the PPS and the utilization of posthospital care. The present study provides a theoretical framework for understanding the effects of the PPS on posthospital care and tests this framework using regression analysis.

3. Theoretical Framework

The PPS was reasoned to exert two opposing influences on the discharging hospital. The first arises from the hospital's Medicare dependence and, therefore, the financial risk imposed by the PPS. Because hospitals receive a fixed payment per case under the PPS, Medicare operating gains and losses are possible. The variability of each hospital's overall operating ratio in relation to these gains or losses depends on the relative importance of its Medicare business. Hospitals more dependent on Medicare face a wider range of potential gain or loss under the PPS. Such hospitals may be more inclined to economize on Medicare inpatient services so as to reduce the likelihood of incurring a large operating loss.[2] Therefore, greater financial risk as gauged by Medicare dependence was assumed to positively influence posthospital care.

The second PPS influence derives from its actual effect on the hospital's overall operating ratio. The incentive to substitute posthospital care for inpatient services was assumed to be inversely related to this financial impact. Hospitals incurring a financial loss under the PPS were reasoned to have more incentive to substitute posthospital care while those incurring a financial gain would have less incentive. While this behavior is inconsistent with profit maximization, hospitals for the most part are not profit maximizers. They are more accurately described as quantity or quality maximizers whose financial objectives may be simply to break even. If this is the case, then a financial gain under the PPS may relax the incentive to substitute posthospital care while a financial loss may intensify it.

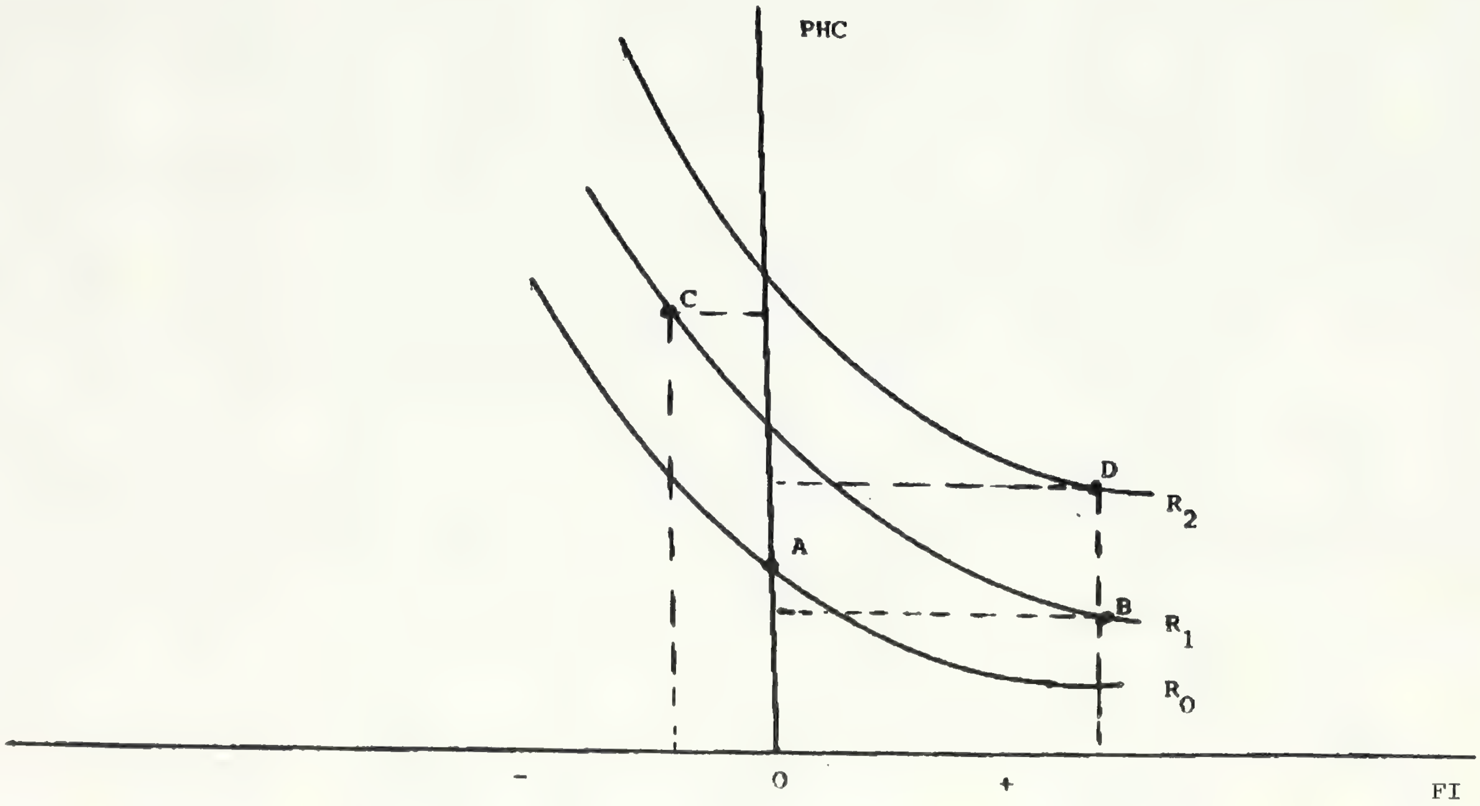
Figure 1 depicts the assumed relationship between the level of posthospital care and the influence of the PPS on the discharging hospital. The level of posthospital care (PHC) is measured on the vertical axis and the financial impact of the PPS (FI) is measured on the horizontal axis. The downward slopes of curves R0-R2 indicate the negative relationship between the level of posthospital care and the PPS' financial impact. Higher curves reflect the increasing financial risk associated with greater Medicare dependence.[3] This risk has a positive influence on the level of posthospital care. R0 is the zero risk situation that would exist in the absence of the PPS, i.e. under cost-based reimbursement. Under cost-based reimbursement, the financial impact of the PPS would also be zero. Hospital A represents this situation. Different situations under the PPS are represented by hospitals B, C and D.

Hospitals B and C are characterized by the same Medicare dependence and face the same financial risks from the PPS. However, the financial impact of the PPS differs for each (because of differences in efficiency, for example). B experiences a financial gain while C experiences a financial loss. The assumed incentives under the PPS are such that C substitutes more posthospital care than B. Alternatively, hospitals B and D experience the same financial impact of the PPS but face different risks, hospital D being more dependent on Medicare. Because of this greater risk, D also substitutes more posthospital care than B. Thus, the impact of the PPS on the utilization of posthospital care depends on the net effect of the two opposing influences.

4. Regression Models

The principal database for this study is an episode-of-care beneficiary file developed by Abt Associates Inc., as part of the Prospective Payment and Analytic Support Studies for HCFA. This file contains a wide range of health care and other data for four groups of diagnostically related Medicare beneficiaries. The four groups are: stroke, pneumonia, hip replacement and hernia. Episodes for the hernia group showed very little posthospital care and were, for this reason, excluded from the analysis. To attain a higher degree of homogeneity, each of the three remaining groups was pared to a smaller number of cases based on one or two DRGs and a limited number of more closely related diagnostic codes (see Appendix A). Hip replacements were further refined by dividing the selected cases into two subgroups: athritis related and fracture related. The resulting four groups, which reflect a higher degree of within-group homogeneity,

FIGURE 1



were analyzed separately. This disaggregation, in conjunction with indicators of case severity, enabled control for the effects on posthospital care of longitudinal and cross-sectional variations in hospital case mix.

The health care data for each beneficiary spans a period encompassing 60 days prior to the focal hospital stay and 60 days post. In addition to information relating to the focal hospital stay, volume and/or charge data were also available for subsequent hospital stays, hospital outpatient services, skilled nursing care (SNF), home health services (HHA) and for physician and other services provided under part B Medicare. The data for these services are disaggregated into pre and post hospital stay. Further disaggregation of the pre and post 60-day periods into shorter periods is also present. This breakdown enabled measurement and analysis of the timing, as well as the volume, of posthospital care. Each type of posthospital care was analyzed separately while taking into account the interdependence of these services.

In addition to the PPS' influence on the discharging hospital, several other factors were expected to affect beneficiary utilization of posthospital care. The care received in the 60-day period prior to the focal hospital stay was viewed as an indicator of case severity and, for this reason, a good predictor of posthospital care. Additional measures reflecting the demand for posthospital care were also specified in the model. Other explanatory variables include geographic factors and supply measures for each type of care. These reflect beneficiary access to posthospital services. They also served as instrumental variables controlling for interdependence among the various types of care consumed by each beneficiary.[4] The utilization of posthospital care may also be influenced by hospital objectives and ability to effectively provide inpatient services. Several measures were specified in the model to capture these hospital characteristics. Finally, year indicators were included in the model to account for trends in the use of posthospital services.

The following model, which summarizes the above, was estimated for each type of posthospital care. Estimates were based on pooled times series and cross-sectional beneficiary level data for the period 1981-86. This period includes approximately three pre and three post PPS years. Several thousand records were available for each of the four diagnostic groups.

Before the model was estimated, steps were taken to ensure that each patient record reflected an episode of care centering on the focal hospital stay. To reduce the possibility that the focal stay was in fact a rehospitalization, all records that showed a hospital stay within the 30-day period preceding the focal stay were excluded from the analysis. Also, records were excluded if subsequent hospitalizations were judged unlikely to have been related to the focal hospital stay. A frequency analysis of primary diagnoses was performed for rehospitalizations. Diagnoses with low relative frequencies were assumed to be unrelated to the focal stay.[5] Finally, records were excluded where the patient died in the hospital or within the 60-day post period.

$$X = f(\text{PPS, CASE SEVERITY, DEMAND, GEOGRAPHIC, SUPPLY, HOSPITAL, TREND})$$

This model states that each beneficiary's utilization of posthospital care is a function of the PPS' influence on the discharging hospital, the seriousness of the beneficiary's condition, other influences on his demand, geographic factors, supply constraints, hospital characteristics and trends.

Dependent Variables

X represents any of several measures of posthospital care. Measures of posthospital care reflect the timing as well as the volumes of these services. The general hypothesis is that the PPS not only affected the volume of posthospital care but also influenced its timing. Where inpatient services were reduced, the stronger need for posthospital care was assumed to accelerate its consumption. The following measures were subjected to analysis.

SNFDAY. Total SNF days utilized by each beneficiary within the post 60-day period.

SNFTIM. The timing of SNF utiliztion measured as the ratio of SNF days in the post 14-day period to those in the post 60-day period.

HHAVIS. Total HHA visits utilized by each beneficiary within the post 60-day period.

HHATIM. The timing of HHA utilization measured as above.

INPDAY. Total inpatient days for beneficiary rehospitalizations occurring within the post 60-day period.

INPTIM. The timing of rehospitalizations measured as above.

PHYSCHG. Total non-hospital-inpatient physician charges for each beneficiary within the post 60-day period. All charges were expressed in 1981 dollars and standardized for cross-sectional differences in costs.[6]

PHYSTIM. The timing of physician charges measured as above.

DMECHG. Total durable medical equipment charges for each beneficiary within the post 60-day period. All charges were expressed in 1981 dollars.[7]

DMETIM. The timing of equipment charges measured as above.

CLVIS. Total outpatient clinic visits for each beneficiary within the post 60-day period.

CLTIM. The timing of clinic visits measured as above.

ERVIS. Total emergency visits for each beneficiary within the post 60-day period.

ERTIM. The timing of emergency visits measured as above.

TOTREI. Total Medicare Reimbursements for each beneficiary for all post-hospital care consumed within the post 60-day period. Total reimbursements were expressed in 1981 dollars and adjusted for cross-sectional differences.[8]

PPS Variables

The two influences of the PPS on the utilization of posthospital care were captured with the following measures.

PPSRSK. This measure captures the discharging hospital's vulnerability to the PPS. It is the product of two variables. The first is the hospital's ratio of Medicare discharges to total discharges (for 1984). This indicates the hospital's Medicare dependence and, therefore, the financial risk imposed by the PPS. The second is a binary variable taking the value of 1 if the stay occurred while the hospital was subject to the PPS and 0 otherwise. In the absence of the PPS, Medicare dependence has no risk implications. Higher values of PPSRSK were assumed to reflect stronger incentives to reduce inpatient services and to increase posthospital care.

PPSFI. This measure gauges the PPS' financial impact. It is also a product of two variables. The first is the increase or decrease in its overall operating ratio that a hospital would experience under the fully implemented PPS if it maintained the same Medicare costs and patient volumes as for the TEFRA year (i.e. did not modify its behavior from what it was in the year immediately preceding the PPS' implementation). This measure of financial gain or loss under the PPS was calculated by multiplying the hospital's projected Medicare operating ratio by its ratio of Medicare costs to total costs.[9] The second variable is the same binary measure described above. Since Medicare gains were assumed to dampen PPS incentives to subsitute posthospital care, PPSFI was expected to negatively affect the volume and timing of pospital care.

Case Severity Measures

Differences in case severity among the beneficiaries in each diagnostic group were captured by a set of variables reflecting each beneficiary's utilization of health care services in the 60-day period preceding the focal hospital stay. The more serious cases within each group were reasoned to consume relatively high levels of health care services in the pre 60-day period; thus, our rationale for using these measures as proxies for case severity. To adjust for the effects of supply constraints on the levels of these services, each beneficiary's consumption of a service during the pre 60-day period was divided by the average pre 60-day consumption of that service for all beneficiaries within the same diagnostic group and with the same state of residence and year of discharge.

HOSPRE. Beneficiary hospital inpatient days during the pre 60-day period divided by the group-state-year average.

SNFPRE. Beneficiary SNF days during the pre 60-day period divided by the group-state-year average.

HHAPRE. Beneficiary HHA visits during the pre 60-day period divided by the group-state-year average.

PHYSPRE. Beneficiary physician charges during the pre 60-day period divided by the group-state-year average.

DMEPRE. Beneficiary medical equipment charges during the pre 60-day period divided by the group-state-year average.

CLPRE. Beneficiary clinic visits during the pre 60-day period divided by the group-state-year average.

ERPRE. Beneficiary emergency room visits during the pre 60-day period divided by the group-state-year average.

Demand Variables

The utilization of posthospital care may also be explained by other beneficiary characteristics that influence demand. These were specified as follows.

AGE. Each beneficiary's age at the time of the focal hospital stay.

SEX. A dummy variable taking the value of 1 if the beneficiary is a male and 0 if female or unknown.

RACEA. A dummy variable taking the value of 1 if a beneficiary is white and 0 otherwise.

RACEB. A dummy variable taking the value of 1 if a beneficiary is black and 0 otherwise.

Age was expected to be positively related to posthospital care while the effects of sex were uncertain. Race was expected to capture cultural and economic constraints on on the consumption of posthospital care. Its influence could, therefore, vary with the type of care.

CAPINC. The per capita income for the beneficiary's county of residence. The relationship between income and posthospital care would also seem to depend on the type of care. Some types of care (e.g. HHA) could be viewed as an inferior substitute for others (e.g. SNF) and, thus, bear a negative relationship with income.

Geographic Variables

The following measures were included to capture geographic affects on the utilization of posthospital care. They are based on a county classification developed by the Appalachian Regional Commission for all U.S. counties (ARC codes). Counties are ranked (1-10) according to geographic isolation, where 1 is the least isolated (i.e. central metropolitan) and 10, the most isolated (i.e. most rural). Rankings were determined primarily by population density and worker in-migration and out-migration.

PATCODE. The ARC code for the beneficiary'county of residence. A higher ranking was assumed to generally imply less access to posthospital care and, therefore, lower utilization. However, certain types of posthospital care (e.g. HHA) may be relatively more abundant in remote areas (because of the scarcity of others such as SNF). For these, the effects of PATCODE may be in the opposite direction.

XCODE. This measure is a composite of three variables. It reflects the geographic divergence between the beneficiary's county of residence and the hospital's county. A dummy variable was first created to indicate whether the two counties were the same (0) or different (1). To create XCODE, this dummy was multiplied by the ratio of the beneficiary's ARC code to the hospital's ARC code. XCODE, therefore, has a range from 0 to 10, where 0 would indicate that the counties are the same. Values between 1 and 10 would indicate that the beneficiary migrated to a more urban county to receive hospital care. The higher are the values, the greater the geographic divergence between beneficiary's county and the hospital's county. The hypothesis here is that geographic divergence in this direction is associated with a lesser ability of hospital based physicians to schedule posthospital care for their patients. They are simply unfamiliar with the healthcare services available in the more remote areas from which their patients migrated. Values of XCODE between 0 and 1 imply that the patient migrated from a less rural to a more rural area to receive hospital care. While this type of gegraphic divergence could have some disadvantages with respect to the scheduling of posthospital care, these were expected to be very minor. Values below 1 are also infrequent. Thus, in general we expected both the level and timing of posthospital care to bear a negative relationship with XCODE.

Supply Variables

The following variables are broad measures of supply for each type of posthospital care. Beneficiaries located in states or BEAAs with more abundant supplies were expected to consume larger quantities of posthospital care and to obtain quicker access.[10] The following measures were either for a single year within the (1981-86) period or averaged over the six years.

HOSSUP. The (1981) ratio of hospital beds to Medicare beneficiaries for each beneficiary's BEAA area.

SNFSUP. The (1981) ratio of SNF admissions to Medicare beneficiaries for each beneficiary's BEAA area.

HHASUP. The (1981) ratio of HHA visits to Medicare beneficiaries for each beneficiary's BEAA area.

PHYSUP. The (1981-86) average physician charges per Medicare beneficiary for each beneficiary's state of residence.

PHYSPOP. The (1983) number of patient care physicians per 100,000 population for each beneficiary's county of residence.

DMESUP. The (1981-86) average medical equipment charges for each beneficiary's state of residence.

CLSUP. The (1981-86) average clinic visits per Medicare beneficiary for each beneficiary's state of residence.

ERSUP. The (1981-86) average emergency room visits per Medicare beneficiary for each beneficiary's state of residence. These supply measures also served as instrumental variables controlling for interdependence among the several types of posthospital care.

Hospital Variables

Hospital characteristics may also influence the quantity and quality of inpatient services and, in turn, affect posthospital care. The following hospital variables where included in the model. (Values are for the same year as the beneficiary record.)

BEDS. The discharging hospital's short term bed complement. Hospital size was assumed to be related to the quality of inpatient services. Higher quality inpatient services may suggest a lesser need for posthospital care.

TCHSTAT. The discharging hospital's teaching status (0-3).[11] This is another indicator of the quality of inpatient services.

HOSDIV. The number of services offered by the discharging hospital (0-20). This is a measure of hospital diversification which is yet another indicator of the quality of inpatient services received by each beneficiary.

PROF. A dummy variable taking the value of 1 if the discharging hospital is for-profit and 0 if voluntary or government. This variable indicates the susceptibility of the hospital to financial incentives such as those present under the PPS. For-profit hospital's were assumed to be more responsive to financial incentives than voluntary or government hospitals. Government hospitals were assumed to be least responsive because of their access to public subsidy.

VOL. A dummy variable taking the value of 1 if the discharging hospital is voluntary and 0 if government or for-profit. The rationale is the same as above.

OCC. The hospital's occupancy rate. It was felt that hospitals with low occupancy rates might be less willing to substitute care in other settings for inpatient services.

Trend Variables

The final variables included in the model are a set of year dummies, YEAR1-YEAR5, to reflect the six-year period 1981-86. These variables should capture trends in the consumption of posthospital care. For example, there appears to have been a movement, which pre-dates the PPS, away from inpatient hospital care to care in other settings.

5. Regression Results

Complete regression results are presented in Appendix B.[12] Since it is the focus of this study, only results pertaining to the PPS are discussed in detail. Also, the large number of regressions makes impractical a lengthy discussion of results for the other explanatory variables.

5.1 PPS Effects

Results for the PPS variables are presented in Table 1. Estimated coefficients and t statistics for PPSRSK and PPSFI are listed by diagnostic group and type of posthospital care. As Table 1 indicates, significant effects of the PPS were observed most often for SNF, HHA and physician services. Also, where significant, the effects of PPSRSK and PPSFI are usually in the predicted direction.

The PPS appears to have affected the volume of posthospital SNF services (SNFDAY) for the Stroke and Hip Replacement (fracture) groups only. For Stroke, the coefficients of both PPSRSK and PPSFI are significant and have the predicted signs. The positive sign of PPSRSK implies that stronger incentive to substitute posthospital care are associated with greater PPS risk as gauged by the Medicare dependence of the discharging hospital. The negative sign of PPSFI suggests that this incentive was inversely related to the PPS' financial impact on the hospital. PPSRSK is also significant and of the expected positive sign for Hip Replacement (fracture). Results indicate that the PPS may have also affected the timing of SNF services (SNFTIM). The coefficient of PPSRSK is significant and has the predicted sign for Pneumonia, Stroke and Hip Replacement (fracture). The positive sign indicates that SNF services were consumed sooner by beneficiaries discharged from hospitals at greater risk from the PPS. Where significant, PPSFI also has the predicted sign. Again, the negative sign suggests that greater financial gain under the PPS may have dampened incentives to shift to posthospital care.

Table 1

PPS Effects

Dependent Variable	PNEUMONIA		STROKE		HIP REPLACEMENT (ARTHRITIS)		HIP REPLACEMENT (FRACTURE)	
	PPSRSK	PPSFI	PPSRSK	PPSFI	PPSRSK	PPSFI	PPSRSK	PPSFI
	Estimated Parameter (t statistic in parenthesis)							
SNFDAY	-.1060 (-.415)	-.2206 (-.378)	2.5696*** (3.281)	-3.4713* (-1.732)	-.0786 (-.147)	-1.8331 (-1.295)	4.2732*** (3.694)	-4.1747 (-1.349)
SNFTIM	.0127** (2.017)	-.0139 (-.959)	.0597*** (5.064)	(-.0001 (-.006)	.0295 (1.422)	-.1076* (-1.951)	.0927*** (3.706)	-.1128* (-1.665)
HHAVIS	.2683 (.887)	-.3834 (-.554)	-.4774 (-.671)	-1.2927 (-.710)	1.0279 (1.148)	-7.1979*** (-3.031)	-.4084 (-.465)	-.5819 (-.248)
HHATIM	.0128* (1.652)	-.0481*** (-2.703)	-.0132 -1.207)	-.0297 (-1.055)	.0417* (1.778)	-.2603*** (-4.178)	-.0330* (-1.874)	-.0168 (-.358)
PHYSCHG	-1.6447 (-.362)	-7.3525 (-.708)	5.2123 (1.036)	-38.5534*** (-2.993)	16.2865 (1.135)	-78.6899** (-2.068)	-5.0576 (-.519)	-84.2142*** (-3.228)
PHYSTIM	.0048 (.321)	-.0084 (-.246)	.0342** (2.071)	-.1207*** (-2.853)	.0702** (2.558)	-.1956*** (-2.688)	.0359 (1.439)	-.0465 (-.697)
INPDAY	-.3828 (-1.463)	-.5120 (-.856)	-.0372 (-.063)	-6.4416*** (-4.280)	-.4415 (-1.001)	-.3579 (-.306)	-.5598 (-1.304)	-.5176 (-.451)
INPTIM	.0032 (.360)	.0288 (1.412)	.0367*** (2.878)	-.0128** (-2.483)	.0061 (.420)	-.0142 (-.365)	-.0106 (-.846)	.0299 (.889)
DMECHG	10.7812 (1.587)	-48.5141*** (-3.123)	-12.6175 (-1.577)	-4.5017 (-.220)	-13.6501* (-1.729)	-18.3022 (-.874)	-5.5126 (-.748)	4.5896 (.233)
DMETIM	.0026 (.377)	-.0320* (-1.967)	.0051 (.471)	.0237 (.854)	.0366 (1.409)	.0353 (.513)	.0205 (1.097)	.0259 (.519)
CLVIS	-.0984*** (-3.263)	.0322 (.467)	.0024 (.107)	.0088 (.149)	-.0346 (-1.160)	.0737 (.929)	-.0595 (-1.588)	-.0061 (-.061)
CLTIM	-.0099** (-2.148)	.0049 (.466)	-.0034 (-.768)	-.0004 (-.402)	-.0114 (-1.610)	.0118 (.625)	-.0133** (-2.281)	-.0127 (-.808)
ERVIS	-.0225 (-.897)	.1164** (2.030)	-.0068 (-.302)	.0271 (.470)	.0228 (.618)	-.2142** (-2.186)	.0143 (.500)	-.0089 (-.117)
ERTIM	-.0017 (-.238)	.0070 (.423)	-.0009 (-.118)	.0063 (.306)	-.0101 (-.832)	-.0315 (-.970)	-.0003 (-.029)	-.0052 (-.179)
TOTREI	16.9959 (.199)	-551.428*** (-2.824)	425.762*** (2.572)	-2442.168*** (-5.764)	12.3008 (.082)	-810.084** (-2.048)	148.360 (1.143)	-811.215** (-2.336)

*** significant at .01 level, ** significant at .05 level, * significant at .10 level

The PPS does not seem to have strongly affected the volume of posthospital HHA services (HHAVIS), at least for the diagnostic groups studied. Significant results were observed in one instance only. The coefficient of PPSFI is significant and has the predicted negative sign for Hip Replacement (arthritis). The timing of HHA services (HHATIM) seems to have been more susceptible to the PPS. The coefficients of PPSRSK and PPSFI are significant and have the predicted signs for Pneumonia and Hip Replacement (arthritis). Again, the stronger incentives associated with greater PPS risk seem to have induced an earlier utilization of posthospital HHA services. And again, these incentives seem to have been influenced by financial gain or loss under the PPS. The coefficient of PPSRSK is also significant for Hip Replacement (fracture). The negative sign, however, is contrary to expectation.

The volume of posthospital physician services (PHYSCHG) appears to have been affected by the PPS for three of the diagnostic groups: Stroke, Hip Replacement (athritis) and Hip Replacement (fracture). The coefficient of PPSFI is significant and has the predicted negative sign in each instance. Shifts to posthospital physician services were weaker among hospitals that experienced financial gains under the PPS and stronger among those that experienced losses. The coefficients of PPSRSK are insignificant. The timing of posthospital physician services (PHYSTIM) seems also to have been affected by the PPS. Significant effects were observed for Stroke and Hip Replacement (arthritis). The coefficients of PPSRSK and PPSFI are both significant in each instance and have the predicted signs. Stronger incentives associated with greater PPS risk seem to have induced a more immediate utilization of posthospital physician services, and these incentives seem to have been dampened or reinforced by the financial gains or losses under the PPS.

Considerably weaker results were observed for the remaining types of posthospital care. Rehospitalizations seem to have been affected by the PPS for one diagnostic group only, Stroke. The coefficient of PPSFI is significant and has the predicted negative sign for the volume of these services (INPDAY). The timing of rehospitalizations (INPTIM) for Stroke also appears to have been affected by the PPS. The coefficients of both PPSRSK and PPSFI are significant and have the predicted signs.

For durable medical equipment (DME), the level of posthospital utilization (DMECHG) seems to have been affected by the PPS in the case of Pneumonia only. The coefficient of PPSFI is significant and has the predicted negative sign while that of PPSRSK is nearly significant and has the predicted positive sign. The coefficient of PPSRSK is also significant for Hip Replacement (arthritis) but the negative sign is contrary to expectation. The timing of DME usage (DMETIM) for Pneumonia also seems to have been affected. PPSFI is significant and has the expected negative sign.

Significant results were observed for posthospital clinic visits (CLVIS and CLTIM) with respect Pneumonia and Hip replacement (fracture). The negative sign of PPSRSK in each instance, however, is contrary to expectation. PPSFI was not significant with respect to these services. Results are generally weak for posthospital emergency room visits. With respect to the volume of these services (ERVIS), PPSFI is significant and has the predicted negative sign for Hip Replacement (arthritis). It is also significant for Pneumonia, but the positive sign is contrary to expectation. The timing of posthospital emergency room visits (ERTIM) seems to have been unaffected by the PPS.

Total Medicare reimbursements (TOTREI) for posthospital care seem to have been everywhere affected by the PPS. The coefficient of PPSFI is significant and has the predicted negative sign for each diagnostic group. The shift to posthospital care appears to have been weaker among hospitals experiencing larger financial gains under the PPS and stronger among those experiencing smaller gains or losses. The coefficient of PPSRSK is significant and has the predicted positive sign for Stroke only.

In sum, the observed effects of the PPS on posthospital care are generally consistent with the theoretical framework. However, there are instances in which the PPS seems to have had effects opposite to what was hypothesized. The significance and negative sign of PPSRSK in a fair number of cases is particularly troublesome. It could be that the posthospital services in question are inferior goods. An increase in the overall demand for poshospital care may have been coupled with a decline in the demand for some services. For example, the PPS seems to have induced a more intensive utilization of posthospital SNF services for Hip Replacement (arthritis) and at the same time, a lesser utilization of home health and clinic visits. This is feasible to the extent that the former are inferior substitutes for the latter.[13]

5.2 Other Influences on Posthospital Care

CASE SEVERITY. Case severity was gauged by each beneficiary's consumption of healthcare services during the 60-day period prior to hospitalization. As expected, these variables are in general positively related to the utilization of posthospital care (though unexplainable negative signs were observed in some instances). By far, the strongest relationships were observed between the same type of service. For example, if a beneficiary consumed a relatively high volume of home health services prior to hospitalization, he was also likely to consume a relatively large amount of these services in the posthospital period. This finding suggests that the type of posthospital care consumed is largely explained by patterns that existed prior to hospitalization.

DEMAND. These include measures of age, sex, race and income. In general, beneficiary age, as expected, was positively related to the utilization of posthospital care. The more notable exceptions are for clinic visits and for total Medicare reimbursements for posthospital services relating to Stroke. The results for sex are mixed. For example, males seem to use less posthospital SNF and HHA services but have considerably more rehospitalization days than females. Males also consume more total posthospital services than females. Results for race were too mixed to draw any general conclusions. Per capita income also had mixed positive and negative effects when significant. It is noteworthy that the negative relationships were observed for rehospitalizations and emergency room visits.[14] Total Medicare reimbursements for posthospital care appear to have been unrelated to per capita income.

GEOGRAPHIC. The effects of beneficiary geographic location (PATCODE) were mixed, depending on the type of posthospital service and diagnosis. For example, beneficiaries residing in more rural areas tended to consume relatively less SNF but more HHA, physician and clinic services. The timing of posthospital care was also related to beneficiary geographic location. The more rural beneficiaries seem to have generally obtained HHA services sooner after discharge, but were slower to obtain DME. Overall, geographic location per se seems to have had no effect on the total amount of posthospital care (TOTREI) consumed by each beneficiary.

It must be cautioned that these findings do not imply that beneficiaries located in rural areas consume levels of posthospital care comparable to those located in urban areas. When supply constraints (broadly measured at the state or BEAA level) are held constant, the analysis reveals different and purer relationships between geographic isolation (measured at the county level) and the utilization of posthospital care.[15]

The access to posthospital care of rural residents who migrate to more urban areas for their inpatient services was also investigated. In general, the use of more urban facilities (XCODE) does not seem to reduce access to posthospital care as had been hypothesized. To the contrary, it appears that such individuals more intensely utilize posthospital services. This is especially true with respect to SNF, HHA and physician services.[16]

SUPPLY. Measures of supply were specified for each type of posthospital care. As would be expected, these generally affected the amounts of these services consumed by beneficiaries. The relationship between a particular type of posthospital care and its supply measure was most often significant and positive. The coefficients for the other supply measures, when significant, varied between positive and negative. This finding is reasonable where some types of care are substitutes while others are complements. For example, for posthospital SNF services the coefficient of the hospital supply measure was generally negative.

HOSPITAL. Results for these variables were often contrary to expectation. For example, Hospital size (BEDS) and teaching status (TCHSTAT) more often than not were positively related to the utilization of posthospital services. It was assumed that both size and teaching status implied a higher quality of inpatient hospital care and, therefore, a lesser need for posthospital services. Perhaps, size and teaching status correlate with more serious cases and our case severity measures did not fully capture these effects. As hypothesized, results indicate that beneficiaries discharged from for-profit hospitals and high occupancy hospitals tend to more intensely utilize posthospital services. The reason for this may be that these hospitals are more responsive to financial incentives to substitute posthospital care for inpatient hospital services.[17] Lastly, beneficiaries discharged from more diversified hospitals (i.e. those with a broader scope of services) seem to less intensely utilize posthospital services. This finding is also as was expected. Such hospitals may provide a higher quality of care or have a greater ability to meet the health care needs of patients. Thus, there may be a lesser need for posthospital services.

TRENDS. Posthospital HHA, Physician and DME services showed increasing trends. No general trends were observed for the other types of posthospital care. Medicare reimbursements for posthospital care also showed an increasing trend.

6. Conclusion

This study investigated the effects of the PPS on the utilization of posthospital care. Several types of posthospital care were analyzed at the beneficiary level for four diagnostic groups. The posthospital period for each Medicare beneficiary encompassed the sixty days following discharge. Both the level and timing of posthospital services were analyzed.

The types of posthospital care that appear to have been most affected by the PPS are SNF, HHA and physician services. For HHA, the PPS seems to have affected mostly the timing of this service. For SNF and Physician services, the effects on level and timing were more balanced. PPS effects on DME usage and rehospitalizations were less frequent among the diagnostic groups studied. While some significant statistical relationships were also observed for clinic and emergency room visits, the direction of impact was usually contrary to expectation. For all four diagnostic groups, the total amount of posthospital care per beneficiary seems to have been affected by the PPS.

The utilization of posthospital care was positively related to the PPS risk faced the discharging hospital (gauged by its Medicare dependence) and negatively related to the PPS' financial impact. Beneficiaries discharged from hospitals at greater risk from the PPS tended to consume higher levels of posthospital care and to consume these sooner after discharge. This tendency seems to have been dampened or reinforced depending on whether the discharging hospital experienced a gain or loss under the PPS.

Because of the conflicting influences of the PPS, it is difficult to determine its net impact on the utilization of posthospital care. Since hospitals on average stood to gain under the PPS (PPS payments were generally more than compensative during its first few years), the overall financial impact of the PPS would likely have been negative. This negative effect was to some extent offset by the positive influence of the financial risk imposed by the PPS. For the four diagnostic groups studied, the financial impact of the PPS (PPSFI) showed more statistical significance than PPS risk (PPSRSK).

When the effects of the PPS on total Medicare reimbursements (TOTREI) are calculated for each of the diagnostic groups, results reveal a positive net influence for Stroke only. The calculations are based on the mean values and estimated coefficients for PPSRSK and PPSFI and are presented in Table 2. For Stroke, the PPS is estimated to have increased Medicare reimbursement for posthospital care by $48.89 per beneficiary. The estmated effects of the PPS are negative for the other three diagnostic groups: -$4.03 for Pneumonia, -$6.08 for Hip Replacement (arthritis) and -$5.68 for Hip Replacement (fracture).

Because the diagnostic groups are not representative, it is impossible to generalize from these results. Therefore, we cannot speculate as to the overall effects of the PPS on posthospital care. However, based on relationships revealed by this study, it seems clear that the effects of the PPS would become more positive if Medicare payments were less generous. This may be occurring. Recent evidence shows that hospital Medicare margins fell steadily between the first (1984) and third (1986) year of the PPS. (See Prospective Payment Assessment Commission, 1988.)

In addition to the PPS, a number of other factors were also found to influence the utilization of posthospital care. These are interesting to the extent that they reflect

Table 2

Net PPS Effects on Medicare PHC Reimbursements per Beneficiary

	$\overline{\text{PPSRSK}}$		Coeff.		$\overline{\text{PPSFI}}$		Coeff.		Net Effect
Pneumonia	(.1467	x	0)	+	(.0073	x	-551.428)	=	-4.03
Stroke	(.155	x	425.762)	+	(.007	x	-2442.168)	=	48.89
Hip Replacement (arthritis)	(.1831	x	0)	+	(.0075	x	-810.084)	=	-6.08
Hip Replacement (fracture)	(.195	x	0)	+	(.007	x	-811.215)	=	-5.68

various constraints on the ability of the PPS to shift care from the hospital to other settings. Sensitivity of the PPS to these constraints will enable it to more effectively achieve its principal objective which is to reduce the utilization of costly inpatient care.[18]

Footnotes

1. For example, evidence exists that the PPS (or the tighter peer review that accompanied it) initially encouraged lower admissions rates, implying higher proportions of more serious cases. Such cases are likely to consume larger amounts of posthospital care.

2. This behavior is consistent with risk aversion.

3. In the absence of the PPS (i.e. under cost-based reimbursement) Medicare dependence does not have the risk implications described here.

4. For example, the volume of home health services consumed by a Medicare beneficiary may depend on the quantity of SNF services consumed and vice versa. Both quantities depend on the supply of each type of care available to the beneficiary.

5. A relative frequency of .02 was used as the cut-off. This was purely a matter of judgment based on observed distributions. In any case, this rather crude method should have the effect of reducing the possibility that a rehospitalization was for an illness unrelated to the focal hospital stay.

6. A CPI was available for each county and each year (1981-86) from Abt's Area Resource File. This enabled deflation of all charges to their 1981 levels. Deflated charges were then divided by the 1984 Medicare wage index (which was assigned to each county) to adjust for cross-sectional differences in costs. The county used in making these adustments was the beneficiary's county of residence.

7. See footnote no. 6.

8. See footnote no. 6.

9. Specifically, the formula is: [(Medicare reveune - Medicare costs)/Medicare revenue] x [Medicare cost/total cost] where the lefthand expression is based on TEFRA unit costs and the righthand expression on TEFRA patient volumes. Basing the measure on TEFRA values is believed to more accurately gauge the PPS' financial impact because it adjusts for hospital behavioral responses that would obscure this effect.

10. While the geographic and supply variables were expected to be correlated, this correlation is far from perfect. First, the geographic measures are at the county level while the supply measures are (with one exception) at the broader state and BEAA levels. Second, the supply of health care services does not depend solely on factors such as population density. Some rural areas have relatively abundant supplies (e.g. some of the north central states) while others have relatively poor supplies (e.g. some of the Appalachian states).

11. There are four categories: nonteaching, non-COTH teaching, COTH teaching but not AAMC university, and COTH teaching and AAMC university.

12. To more sharply convey the essence of the regression results and to avoid overwhelming the reader, estimated parameters and t statistics have been replaced with + 's and -'s to indicate statistical significance and direction of impact.

13. In the case of clinic and emergency room visits, contradictory results could be explained by the much poorer quality of the data for these services.

14. This finding reflects a known tendency for lower income individuals to wait longer before receiving necessary care and consequently, to be more prone to emergencies and rehospitalizations.

15. For example, a rural beneficiary may consume relatively more HHA services than SNF services in comparison to an urban beneficiary. However, the urban beneficiary may consume larger amounts of both services because of more abundant supply. The inclusion of the supply measures in the regression models would allow the geographic variable to be positively related to HHA use and negatively related to SNF use. If the supply measures were excluded, the geographic variable would also serve as a proxy for supply and, as a consequence, might be negatively related to both services.

16. This finding may simply reflect the possibility that individuals who are motivated to obtain better inpatient hospital care in urban areas are also likely to more intensely seek health care services in general. Thus, the findings do not necessarily show that such individuals have better access to posthospital care.

17. The incentive for for-profit hospitals is obvious. Their payments under the PPS remain the same if they substitute posthospital care for inpatient services, thus enabling them to earn higher profits. High occupancy hospitals may have more incentive to substitute posthospital care simply because the opportunity costs of not doing so are high, i.e. their more limited marginal capacity can be more effectively used elsewhere.

18. For example, the greater willingness of for-profit hospitals to substitute posthospital care may indicate the need for stronger incentives to be applied to voluntary and government hospitals.

Appendix A

The four diagnostic groups analyzed in this sutdy include the following DRGs and primary diagnoses:

1. Pneumonia: DRGS 89 and 90; all primary diagnoses.
2. Stroke: DRG 14; all primary diagnoses.
3. Hip Replacement (athritis): DRG 209; all primary diagnoses beginning with 715.
4. Hip Replacement (fracture): DRG 209; all primary diagnoses encompassed by 800-829.

SELECTING TRACERS

READMISSIONS AND
TRANSFERS

RISK ADJUSTED
MORTALITY

Appendix B

Regression Results

SELECTING TRACERS

READMISSIONS AND TRANSFERS

RISK ADJUSTED MORTALITY

Table 3

	REGRESSION RESULTS: PNEUMONIA N=26,586														
	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTREI
CONSTANT	-	-	-	-	+	+		+	+		+		-	+	
PPSRSK		+		+					+		-	-			
PRSFI				-					-	-			+		-
HOSPRE	+			+			+		+	+			+		+
SNFPRE	+	+	-	-									+	+	
HHAPRE		+	+	+			+		+	+					+
PHYSPRE	+	+			+	+	+	+	+				+	+	+
DMEPRE			+	+			+		+	+			+	+	+
CLPRE						-					+	+	+	+	
ERPRE			+		+	+	+				+	+	+	+	+
AGE	+	+	+	+	-		+		-	+	-	-	-	-	
SEX	-	-			-		+	+	+	+					+
RACEA											-	-	-		
RACEB							-								
CAPINC															
PATCODE				+	+	-				-	+				
XCODE			-	+		-									
HOSSUP	-	-	-	-	-	-		+							+
SNFSUP	+	+		+		-	-								

Table 3 (continued)

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTRE1
HHASUP	-	-	+	+						-					
PHYSUP		+	+	+	+	+			-	+					+
PHYSPOP					+						+				
DMESUP	+			+					+	+			+		
CLVSUP			-	-					-	-	+	+			
ERVSUP		+				+	+		-	-			+	+	+
BEDS	+					-		-						-	
TCHSTAT	+					+				+	+	+			+
HOSDIV	-				-		-		-				+		-
PROF	+			+					+		-	-			+
VOL									+		-	-			
OCC	+				+	+	+	-	+						+
YEAR1			-	-	-	-			-	-				-	-
YEAR2			-	-	-	-			-	-	-		-	-	-
YEAR3				-	-	-			-	-	-	-	-	-	-
YEAR4				-	-				-						
YEAR5				-	-										

+ or - indicates significance at the .10 level or better.
blank indicates statistical insignificance.

Table 4

REGRESSION RESULTS: STROKE N=20,864

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTRE1
CONSTANT	-	-				+	+	+	-				+		+
PPSRSK	+	+				+		+							+
PPSFI	-				-	-	-	-							-
HOSPRE				+											
SNFPRE	+	+													
HHAPRE		+	+	+		-			+	+					+
PHYSPRE	+				+	+	+				-	-			+
DMEPRE			+	+				-	+	+	+		+		+
CLPRE								+			+	+	+		
ERPRE	+										+		+	+	
AGE	+	+		+	-		-	-	+	+	-		-		-
SEX	-	-	-	-			+	+	-	-		+			+
RACEA		+	-								-				-
RACEB			+	+	-	+		-	+	+					
CAPINC				+											
PATCODE	-		+		+	-				-	+				
XCODE			+	+		-		-	+						
HOSSUP	-		-	-	-	-	-	-							
SNFSUP	+	+	-					+		-					+

Table 4 (continued)

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTREI
HHASUP		-	+	+		-			+			+			
PHYSUP		+	+	+	+	+			+	+					+
PHYSPOP					+						+				+
DMESUP							-	-	-	+					-
CLVSUP		-	-	-		-		-	-	-	+	+			-
ERVSUP					+	+	-			+	+		+	+	-
BEDS			+				+	-			+				
TCHSTAT						-				-	+	+			+
HOSDIV		+	-							-					
PROF	+		+			+		-			-		-	-	+
VOL	+	+	-			+	-	-			-				-
OCC		-	+	+				-	+	+		-			
YEAR1	+		-	-	-	-	-	-	-	-		+			-
YEAR2	+		-	-	-	-			-				-		-
YEAR3	+	+	-	-	-	-			-				-	-	
YEAR4	+			-	-	-			-						
YEAR5	-				-					+	+				

+ or - indicates significance at the .10 level or better.
blank indicates statistical insignificance.

Table 5

REGRESSION RESULTS: HIP REPLACEMENT (ARTHRITIS) N=7,138

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTRE1
CONSTANT	-	-	-	-	-	+					+	+			-
PPSRSK				+		+			-						
PPSFI		-	-	-	-	-							-		-
HOSPRE	+									-					
SNFPRE		+		-		+		+							
HHAPRE			+	+											+
PHYSPRE				+	+	+					+				+
DMEPRE	+		+	+					+	+			+		+
CLPRE						-					+	+			
ERPRE					+						+	+	+	+	
AGE	+	+	+	+		+	+				-				+
SEX	-	-	-	-			+	+		-					
RACEA	-														
RACEB		-	+					-			+				
CAPINC			+		+		-	-	-		+		-		
PATCODE		+	+	+		+				-	+		+		
XCODE	+	+	+	+	+	+	+	+	+			-			
HOSSUP		-	-	-		-									
SNFSUP	+	+			-			-							

Table 5 (continued)

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTREI
HHASUP			+	+					+	+			+		+
PHYSUP		+	+	+	+				+	+	-	-			+
PHYSPOP			+												
DMESUP		+			-				+	+					
CLVSUP	-									-	+				
ERVSUP			-	-	+					-					
BEDS			+	-								-			+
TCHSTAT									-		+				
HOSDIV			-				-					+			-
PROF			+						+	-	-			+	
VOL			-			-				-	-		+		
OCC			+	+		-	+			+					+
YEAR1			-	-			-		-	-	+				-
YEAR2			-	-			-		-	-					-
YEAR3			-	-			-	-	-	-	+				-
YEAR4				-			-		-	-					-
YEAR5				-			-								-

+ or - indicates statistical significance at the .10 level or better.
blank indicates statistical insignificance.

Table 6

	REGRESSION RESULTS: HIP REPLACEMENT (FRACTURE) N=9,712														
	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTRE1
CONSTANT	-	-	+	+		+				+	+		-		-
PPSRSK	+	+		-		+					-	-			
PPSFI		-			-	-									-
HOSPRE	+		-	-		-				-					
SNFPRE	+	+		-	+										
HHAPRE	+		+	+	+	+			+						+
PHYSPRE	+	+									+		+	+	+
DMEPRE	-	-	+	+					+	+					+
CLPRE			+						+		+	+	+		
ERPRE	-				-				+				+	+	
AGE	+	+	-	-		+				-			+		+
SEX		-			-	-	+			-					+
RACEA	+	+							+		-				
RACEB		-	+				+		+						+
CAPINC	+	+			+										
PATCODE										-		-			
XCODE	+		+	+				-	+						+
HOSSUP	-		-	-	-	-		+							
SNFSUP	+	+			-				-	-	-	-			+

Table 6 (contined)

	SNFDAY	SNFTIM	HHAVIS	HHATIM	PHYSCHG	PHYSTIM	INPDAY	INPTIM	DMECHG	DMETIM	CLVIS	CLTIM	ERVIS	ERTIM	TOTRE1
HHASUP		-	+	+		-	+						+	+	+
PHYSUP		+	+	+	+				+	+			-		+
PHYSPOP						-					+				+
DMESUP	+					+			+	+					+
CLVSUP	-	-			-	-			-	-	+				
ERVSUP			-				-				-		+	+	-
BEDS	+		+	+	-	-						-	-	-	+
TCHSTAT				-					-		+	+			
HOSDIV		+			-				-						
PROF	+		+			+					-	-			+
VOL			-			+					-	-			
OCC			+	+	+				+			-			
YEAR1	+		-	-	-	-	-		-	-		+			-
YEAR2	+		-	-	-	-			-	-					-
YEAR3	+		-	-	-	-	-	-	-	-					-
YEAR4	+			-		-			-	-					
YEAR5				-			-								

+ or - indicates significance at the .10 level or better.

blank indicates statistical insignificance.

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SELECTING TRACERS

READMISSIONS AND TRANSFERS

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SELECTING TRACERS

PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--

READMISSIONS AND TRANSFERS: THE EFFECTS OF PPS

Working Paper

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Abstract

This paper has attempted to measure changes in readmission and transfer rates that might reasonably be attributable to PPS by accounting for many of the other factors that can be expected to influence these rates. While there is considerable variation across different tracer categories, in analysis of beneficiary level data, a dummy variable measuring the onset of PPS suggests that the rate of readmission has increased for all. The surgical tracers, hip replacement and hernia repair, have experienced the largest growth. Hospital characteristics do not play a strong role in explaining differences in the probability of readmission, but patient characteristics are important. One unmeasured attribute, changing case mix, may explain some of the trend associated with PPS, although some of that effect appears to be measured by length of stay. Length of stay is positively related to the probability of readmission, probably because both are affected by a patient´s severity, although it is impossible to rule out the hypothesis that longer hospital stays themselves increase the likelihood of readmission. There is no evidence, however, to suggest that the shortened lengths of stay found today are leading to more readmissions in aggregate. Analysis of time series of hospital level data also shows an increase in the rate of readmission between 1981 and 1986, but attributes most of the growth to a simple linear time trend. Work at the hospital level is more preliminary than at the beneficiary level, however.

A subset of readmissions that can reasonably be attributed to complications resulting from the initial stay was also examined for hip replacement and hernia repair cases. These readmissions have also shown a significant increase since the beginning of PPS. They appear to be less affected by patient characteristics, which is not surprising if they are true complications from inappropriate care.

Finally, rates of transfer to other hospitals were examined over time and by hospital characteristics. There appears to be no increase over time for any of the tracers. The hospital characteristics associated with exporting hospitals: small size, rural location, and a low occupancy do not suggest that costly patients are being dumped to lower quality hospitals, but without information on the importing hospitals, it is impossible to draw firm conclusions.

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READMISSIONS AND TRANSFERS:
THE EFFECTS OF PPS

1. Introduction

There are at least two reasons why the introduction of prospective payment to hospitals (PPS) by Medicare may have led to an increase in the rate of readmission to a hospital following an initial stay. First, since PPS has created the incentive to discharge patients earlier, patients may also be in a less healthy condition at discharge which may in some instances lead to their readmission. Second, since hospitals are paid a fixed amount per hospital stay (depending on the DRG) regardless of the number of illnesses treated or services rendered, an incentive is created to "unbundle" each hospital stay and require a person to be rehospitalized for separate problems. The former incentive suggests that the number of readmissions due to complications from an initial hospitalization might have increased. The latter implies that the number of readmissions for unrelated events could have risen. Both imply that the total rate of readmission may have increased under PPS.

The rate of readmissions to the same or a different hospital[1] following an initial hospital stay is often viewed as a measure of the quality of care received during the initial stay. In order to use the readmission rate appropriately as a measure of quality of care or for utilization review, it is critical to develop a measure of a benchmark rate of readmission.

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[1] The terms readmission and rehospitalization will be used interchangeably in this paper to mean readmission to the same hospital as the initial stay or to a different hospital within a certain specified window of time.

The optimal measured rate of readmission is not zero for several reasons. First, in some cases, follow-up care is warranted and planned during the initial stay. Second, measurement of the exact set of readmissions that are directly attributable to a previous hospital stay is difficult. It requires determination of the optimal "window of time" in which to examine care received following hospitalization. Too short a time frame following initial hospitalization underestimates the number of rehospitalizations. Too long a time period leads to inclusion of ´rehospitalizations´ that actually have nothing to do with the initial stay. Third, even if it were possible to reduce the probability of readmission for a given condition to zero, most cost-benefit analyses would probably not recommend such a treatment policy.

Readmission is attributable to at least four causes. First, some readmissions may be planned follow-ups of care rendered during the initial stay. Second, some may be totally unrelated to the initial admission and would not really be classified as readmissions except for the fact that they occur within a limited time period following the initial discharge. Third, some readmissions may occur because insufficient post-hospital care in a non-hospital setting, e.g. nursing homes or home health agencies, is provided. Care that is provided could be insufficient either because providers do not exist or because discharge planning is inadequate. When post-hospital care is provided, its timing may be crucial in preventing subsequent hospitalization. Finally, some readmissions may result from inappropriate care during the initial stay. It is this last set of readmissions that is of most concern in this paper.

Simple trends are insufficient to determine the effects of PPS on rehospitalization. The more severe case mix found in hospitals today relative to five years ago, is due to increased use of ambulatory settings for less severe conditions. This suggests that some increase in rehospitalizations would not be surprising and might not be attributable to an inappropriate lessening of care. Regressions presented below will therefore attempt to hold constant various indicators of patient severity. In addition, in order to mitigate the noise created by case-mix variation across geographic regions or time, the analysis focuses on four specific ´tracer´ disease or surgery categories: stroke, pneumonia, inguinal hernia repair, and total hip replacement. Results are also presented from a general file containing random diagnoses, because it may provide more of a summary measure, but its results may be misleading if the case mix problems mentioned above are important.

Another way to isolate those readmissions that result from inappropriate care during the initial stay is to focus on particular diagnoses upon readmissions. While diagnoses do not provide a perfect segregation system, they at least begin to indicate which readmissions might have been caused by the care (or the lack thereof) received initially. Post-operative infections or hemorrhages, for example, are generally inappropriate and suggest that quality of care may have been inadequate or insufficient in the first hospital visit. The list of diagnoses indicating a complication varies across original diagnoses or procedures. In general, surgical procedures have more obvious complications than do medical admissions. Therefore, this part of the analysis focuses on the two surgical tracers mentioned above, total hip replacement and inguinal hernia repair.

Transfers, defined as a rehospitalization to a different hospital within 24 hours of discharge from the initial hospital, also raise several policy questions. The Consolidated Omnibus Budget Reconciliation Act (COBRA) of 1985 made it illegal to transfer medically unstable patients. However, since PPS creates an incentive for hospitals to "dump" their expensive patients on hospitals that cannot refuse them, it is important to determine whether the number and types of transfers have changed in recent years.

Beyond simple time trends of transfers, which suffer from the same potential pitfalls as trends in the rate of readmission, this paper examines whether certain types of hospitals tend to be the transferring hospitals (exporters). Unfortunately, current data files do not identify the receiving hospital so an analysis of transfer "importers" is not possible. An examination of the pattern of exporting hospitals should provide some information, however. Less concern is probably appropriate if most of the exporters are small rural hospitals than if they are major urban teaching hospitals.

The paper is organized as follows. Section 2 describes the data used in this paper. Section 3 provides some general descriptive findings of trends in readmission rates in recent years for the four tracers studied and for the class of general discharges and summarizes the scant existing literature on transfers and readmissions. Section 4 presents some regression results that estimate the change in readmission rates during the last six years while holding constant the effect of various patient, hospital, and market characteristics on the probability of being readmitted within certain windows of an initial hospital discharge. Section 5 examines trends in readmissions due to certain complications arising from hip replacement or hernia repair procedures. Section 6 discusses transfers from one hospital to another. Section 7 provides a conclusion.

2. Description of the Data

Most of the data for the analyses described in this paper are observed at the beneficiary level. An observation describes a Medicare beneficiary's total utilization during an episode of care surrounding hospitalization. These files enable us to examine the probability of a given beneficiary being readmitted to a hospital within certain time periods following his/her discharge from the initial stay. Each file contains information on one of four tracer categories: hip replacements, hernia repairs, stroke cases, and pneumonia. A fifth file describes a set of discharges not stratified by tracer diagnosis.[2]

The beneficiary files contain data on all Medicare utilization by the beneficiary for 60 days before and after admission to the hospital. Thus it is possible to examine not only patterns in hospital utilization but also in outpatient and physician services. In addition to containing demographic information about the patient, the files describe the characteristics of the stay, such as whether it is surgical, how many intensive care or coronary care days are used, and how long it is. In addition there are hospital and market characteristics on the file. The data on these files span from 1981 through 1986.

In a second type of file, used slightly in the analysis that follows, the unit of observation is a hospital quarter.[3] This file contains information on the proportion of all discharges from the hospital within the quarter who are subsequently readmitted to the same or a different hospital. The hospital file contains quarterly observations of total Medicare admissions as well as admissions in each of the four tracer categories. Readmissions and outpatient care linked with the same set of admissions are also measured. Therefore, this file can be used to analyze rates of admission and readmission with respect to the characteristics of hospitals and the markets in which they are located.

---

[2] The latter file includes diagnoses not in the four tracer categories as well.

[3] Further work needs to be done with this file.

Data for both sets of files are extracted from the 20% sample of Medicare beneficiaries (those with terminal digits of 0 and 5 for the claim account number). Part A utilization data are linked with Part B utilization, although for the purposes of this paper only the hospital (Part A) utilization will be studied. The tracer beneficiary files contain a random sample of 8000 beneficiaries for each year (1981-1986) who were admitted with primary diagnosis or any surgical codes for the specified tracer. Table 1 shows which diagnostic or surgical codes are used to define each tracer. Since 8000 admissions with the appropriate diagnoses for hip replacement and hernia repair did not exist, the complete set of such admissions is included in the files. Finally, the general beneficiary file contains a random sample of 8000 admissions (with any diagnosis) for each of the six years covered in the data sets. In all cases the data set used in the analysis of readmissions and transfers is limited to those beneficiaries who are discharged (from their initial visit) alive. In addition we eliminate all beneficiaries in the last quarter of 1986 since their records may not contain a complete history of the post-hospital care used.

TABLE 1

ICD-9-CM DIAGNOSTIC AND PROCEDURE CODES WHICH DEFINE THE TRACER CONDITIONS

HIP REPLACEMENT

PROCEDURE CODES

815 8150 8151 8159 816 8160 8161 8162
8163 8164 8169

STROKE

DIAGNOSTIC CODES

431 4310 43100 433XX 434XX 436 4360 43600

INGUINAL HERNIA

PROCEDURE CODES

530X 531X

PNEUMONIA

DIAGNOSTIC CODES

481 4810 48100 482XX 483 4830 48300 485
4850 48500 486 4860 48600

NOTES.

1. Conditions were determined by checking the codes in the order in which the conditions are listed in the table. That is hip replacement was checked for first, then stroke, followed by hernia, and finally pneumonia.

2. Diagnostic codes must appear as the principal, i.e. first, diagnostic code to be considered a tracer. Procedure codes could appear in any of the three possible positions.

3. If a code listed in the table is shorter than its maximum length, then the remaining positions of the code must be blank to be considered a tracer.

4. The characters X or XX in a code mean that any digit is permissable in those positions.

3. Trends in Readmission Rates

Figure 1 shows the proportion of individuals who are discharged live from a hospital who are subsequently readmitted within windows of time following discharge. The windows include 7, 14, 30 and 60 days in order to examine the time path of readmissions. All five categories appear to show at least slight increases over the 1981-1986 time period analyzed, but the rate of increase varies considerably. The surgical tracers, hip replacement and hernia repair, show the largest increases in readmission rates.

Previous work by Anderson and Steinberg (1984) showed that between 1974 and 1977, over 22 percent of all Medicare beneficiaries who had been hospitalized were readmitted within 60 days. This rate is not dissimilar to that found today.

According to several other studies, the readmission rate has not changed significantly since the introduction of the prospective payment system. A study of Medicare discharges between 1980 and 1984 (DesHarnais, et al. (1987)) found that the readmission rate did not increase significantly in 1984, the first year in which all hospitals in the study were under PPS. Using a limited definition of readmissions to the same hospital within the same quarter, the authors predicted a readmission rate of 13.98% for 1984, had PPS not been instituted. The observed rate was 14.66%, an increase which was not significant at $p < .05$. (DesHarnais) An overview of the first three years of PPS (Guterman et al., 1988) reported that there was no significant

FIGURE 1

PERCENTAGE OF LIVE DISCHARGES WHO ARE READMITTED WITHIN 7, 14, 30, OR 60 DAYS

1981-1986

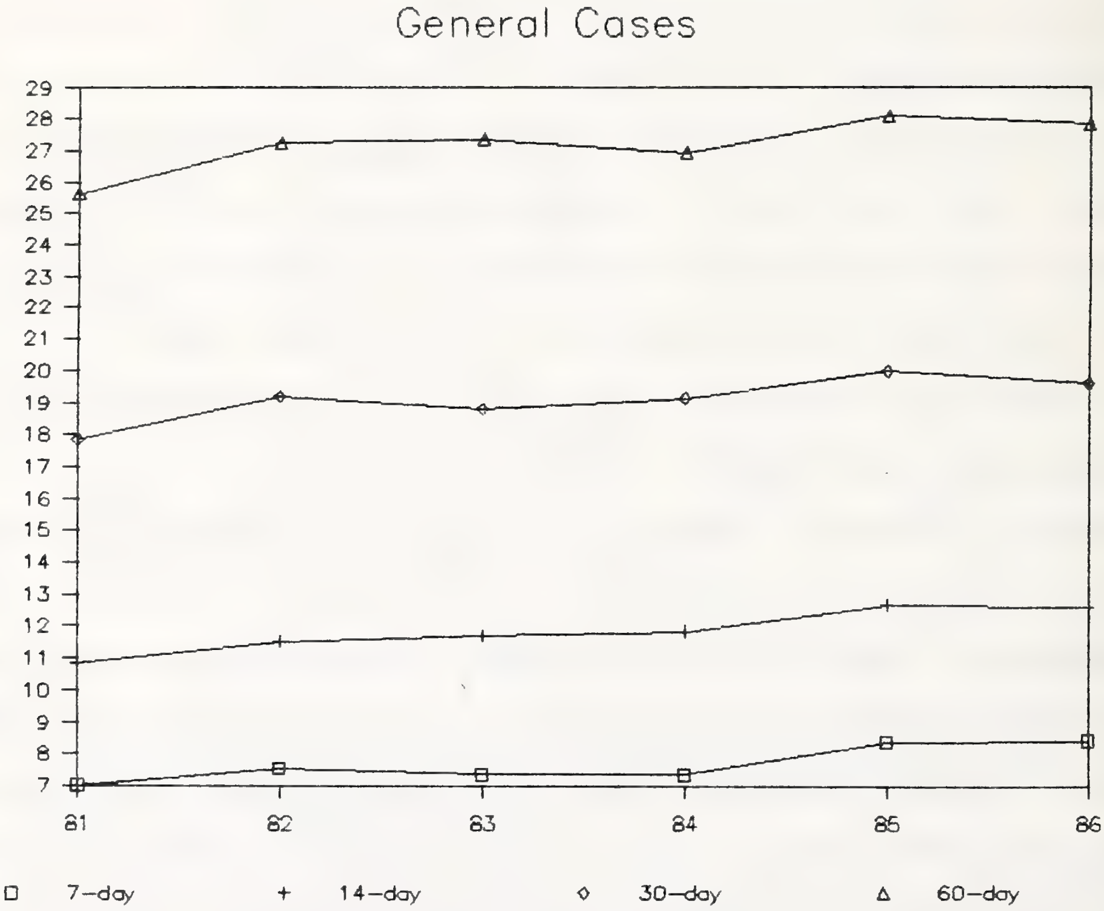
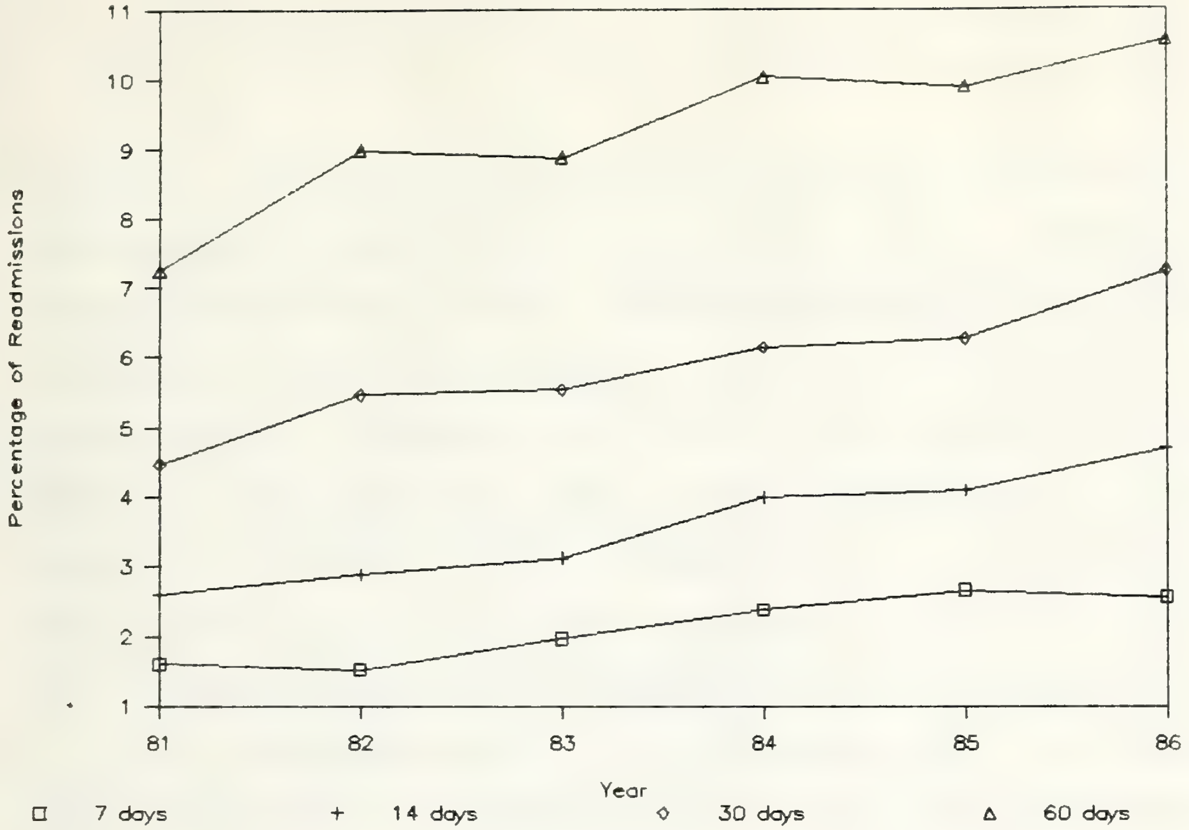
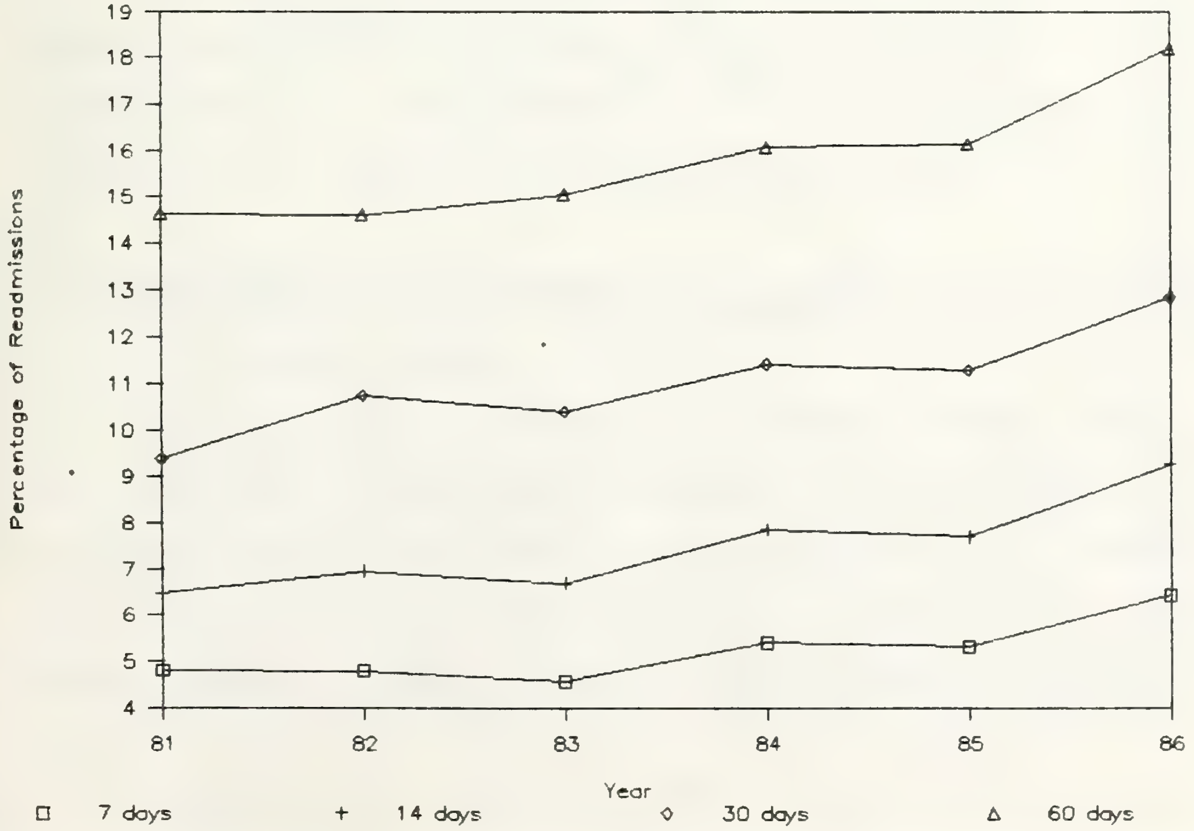


Figure 1 (cont.)

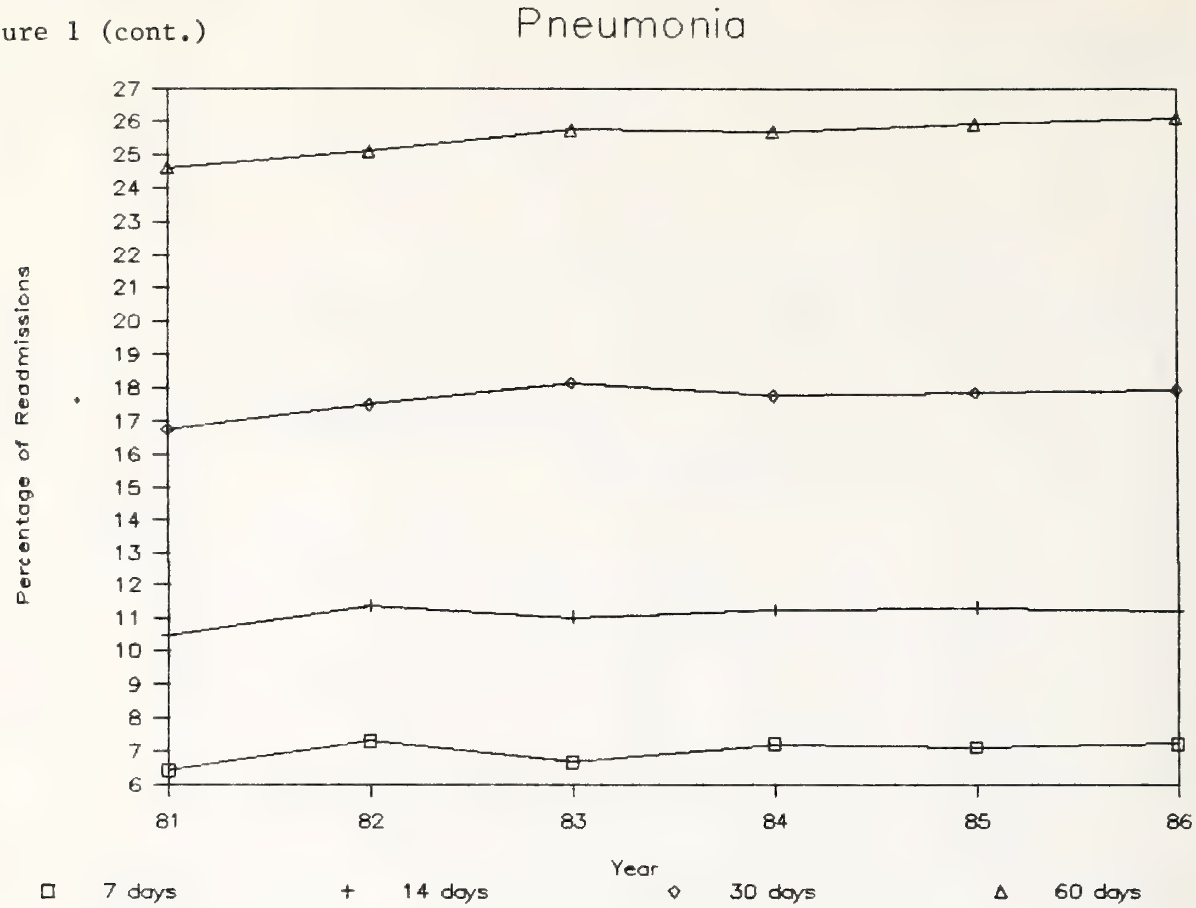


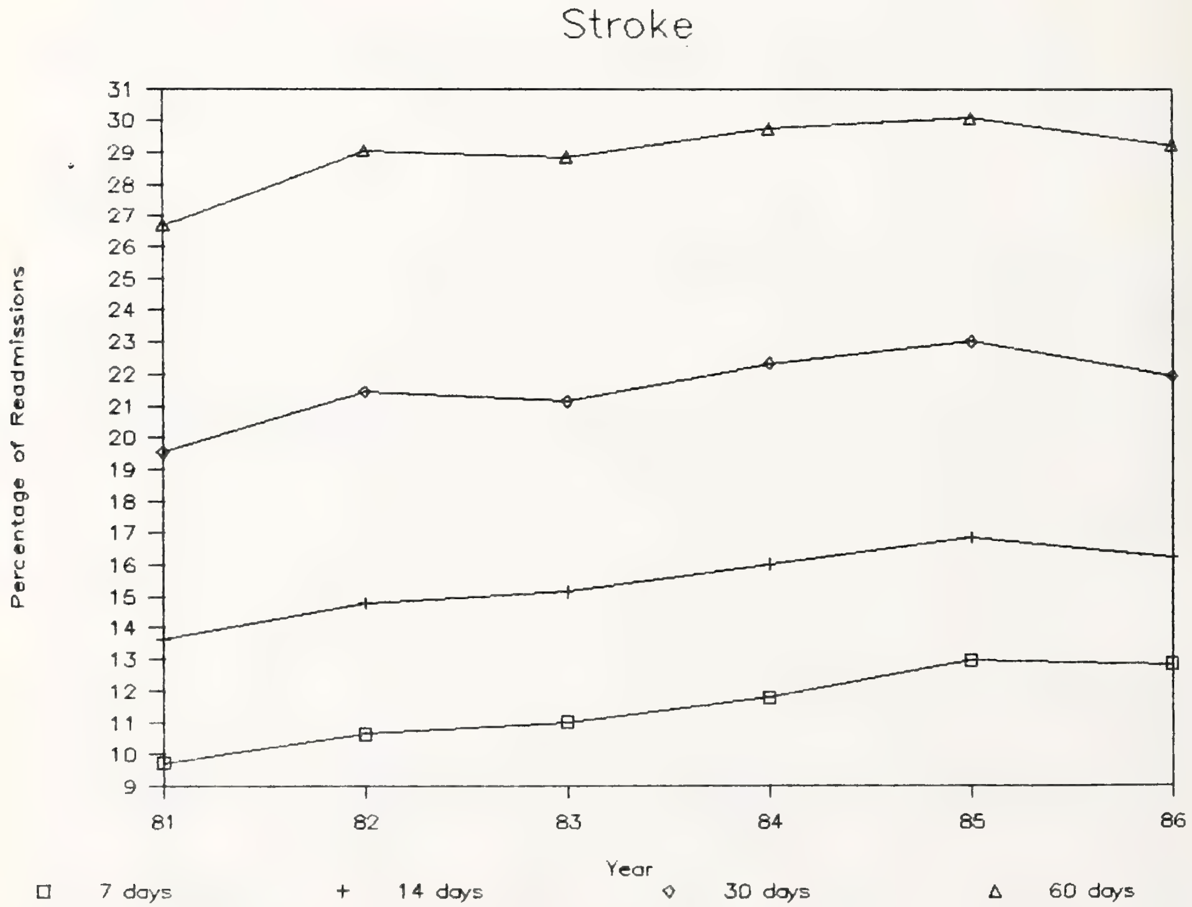
Hernia



Hip

Figure 1 (cont.)





SELECTING TRACERS

change in the rate of Medicare readmissions within 30 days of discharge from a hospital. One study did find a "PPS effect". Weinberger, et al. (1988) compared diabetes patients admitted before and after the introduction of PPS at one hospital and observed that the readmission rate of the cohort admitted after PPS began was higher than that of the Pre-PPS group (24.1 % vs 11.8%). However, the difference was not statistically significant (P=.13) by standard benchmarks, and it is not clear that the methodology used was sound.

In a related analysis, a recent Rand study, reported on in **Medicine and Health** (5/30/88) looked at the rate of transfers from skilled nursing facilities to acute care hospitals and found that the rate declined slightly from 21.5% in 1981 to 20% in 1984-85.

None of the studies cited above, however, have attempted to hold constant the numerous patient, hospital and market conditions that surely affect the rate of readmission. The work described in the next section attempts to do this.

4. Regressions Describing the Determinants of Readmission Rates

a. Variables Used

The regressions are designed to measure changes over time in the probability of being readmitted to the hospital within a certain window of time, while holding constant any changes that have occurred in patient, hospital or market characteristics. Table 2 lists the explanatory variables used as controls in the

RISK ADJUSTED MORTALITY

regressions. Each group is discussed briefly below.

The effect of implementing the PPS program is measured in two different ways. Both account for the fact that different hospitals came under PPS at different times and that hospitals in waivered states were not directly affected by PPS during its early years. First, a dummy variable is set to equal one if the beneficiary's initial stay occurs in a hospital operating under PPS, and is zero otherwise. Second, a time trend is set to zero for all stays occurring in hospitals not operating under PPS and equals the number of years PPS has been in effect at the hospital when the beneficiary stays there. This latter specification allows for a gradual adjustment to PPS.[4] As is true with all time dummy variable specifications, it is never possible to attribute definitively any measured effects solely to the program in question since any contemporaneous event could be equally responsible. By defining the time period carefully, however, it is possible to limit the number of alternative explanations.

The Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) preceded PPS by one year for most hospitals. Per case payments under TEFRA were based on the average cost per case in 1981 for a given hospital; hospitals whose costs exceeded the predetermined

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[4] Two alternative trend specifications were also tried. One set the trend equal to one in the first year that PPS was in place (instead of waiting until after PPS had been in effect for a year), two the second year, etc. The second assumed a step-wise adjustment process, whereby the trend equalled one for admissions occurring during the first year of PPS, and two thereafter. Neither of these specifications fit the data as well as the trend reported.

TABLE 2

EXPLANATORY VARIABLES INCLUDED IN THE REGRESSIONS

Beneficiary Level

Beneficiary Descriptors

AGED	Dummy variable indicating aged Medicare Status
AGE	Age at time of admission
FEMALE	Dummy variable indicating Female
NONWHITE	Dummy variable indicating non-white beneficiary

Descriptions of the Stay

ICCU_YN	Usage of Intensive Care or Coronary Care Facilities (Dummy variable indicating any usage)
SURG_DUM	Dummy variable indicating surgery during the initial stay (not included in hip and hernia regressions)
SURG_YN	Dummy variable indicating additional surgery (beyond 1)
LOS	Length of stay
LOSSQRD	Length of stay squared
IPRDAY60	Number of days in hospital during 60 days prior to initial admission (that triggered readmission)

Hospital Variables

PROF_DUM	Dummy variable indicating proprietary hospital
GOV_DUM	Dummy variable indicating public hospital
BED_DUMx	Various dummy variables indicating hospital bed size 1: <50 Beds 2: 50-99 Beds 3: 100-199 Beds 4: 200-299 Beds 5: 300-399 Beds
TCH2_DUM	Dummy variable indicating minor teaching hospital
TCH3_DUM	Dummy variable indicating major teaching hospital

HOSOCC	Hospital Occupancy Rate
HOS_RUR	Dummy Variable indicating hospital located in rural county

Characteristics of the County of Beneficiary Residence

CAPINC	Per Capita Income
EDUC	Median Years of Education
NHBPOP	Nursing Home Bed - Population Ratio
PHYSPOP	Physician - Population Ratio
SPMDPCT	Percentage of Physicians who are specialists
HMOPOP	Percentage of the population enrolled in a HMO

Regulatory Indicators

PPSDUM	Dummy variable indicating hospital was under PPS during time of beneficiary´s initial stay
TREND	Trend equal to the number of years the hospital had been under PPS at time of beneficiary´s stay
TEFRA	Dummy variable indicating hospital was under TEFRA during time of beneficiary´s initial stay

Variables in the Hospital Regression that Differ from Beneficiary Regression

Patient Variables

CMI	Average Medicare case mix index for hospital during quarter
ICCU	Percentage of Medicare patient days in ICCU
LOS	Average Medicare length of stay
SS	Percentage of Medicare stays involving surgery
PREUSE	Percentage of Medicare stays where beneficiary had been in hospital during 30 days prior to stay

Hospital Variables

SIZEx	Hospital size variables (categories correspond to BED_DUM in beneficiary regressions)

RURAL	Hospital in Rural area
OCCRATE	Average hospital occupancy rate

Area Variables

CTYEMP5K	Percentage of Population working for firms with more than 5000 employees
POPDENS	Population Density

Regulatory and Time Variables

PPS	Dummy variable indicating hospital under PPS
WAIV_DUM	Dummy variable indicating hospital in waivered state
TEF_DUM	Dummy variable indicating hospital under TEFRA
TREND	Linear Trend Measure increasing each quarter (1-24)
PPSTREND	PPS*TREND

amount forfeited part of the difference while those whose costs fell short of the ceiling were allowed to pocket part of the difference. Thus, TEFRA can be expected to have created many of the same incentives as PPS.

Basic demographic characteristics of the patients including age, race and sex are included. In addition, demographic characteristics of the county in which the patient resides, such as average per capita income and the median number of years of schooling completed, are measured. No particular predictions are made on the appropriate signs of effects of these variables.

The regressions also control for characteristics of the patient's initial stay and previous hospitalization history. Since average lengths of stay have shortened dramatically during the 1980s, it seems important to determine what effect, if any, this trend has had on the rate of readmission. As discussed earlier, it is possible that shortened lengths of stay have heightened the probability of readmission. On the other hand, it is also possible that shorter stays are beneficial because they reduce the likelihood of contracting nosocomial infections and shorten long periods of immobility.

It may be difficult, however, to isolate the effect of length of stay and changes in lengths of stay on the probability of readmission, if, as would not be surprising, length of stay is positively associated with the severity of a case. Unfortunately, given existing data, it is impossible to control completely for differences in case mix across patients. Analyzing single tracer categories mitigates the problem somewhat, but differences remain among patients of a given tracer. The regressions include other characteristics of the stays such as whether intensive or coronary care facilities are used, and whether one or more surgical procedures is undertaken during the stay. In addition, the effect of hospitalizations during the prior 60 days (to the initial hospital stay in the episode of care being analyzed) is measured. All of these variables are thought to affect the severity of a given case, but unfortunately do not explain it completely.[5]

Characteristics of the hospital to which the patient is initially readmitted are also included. These should indicate whether an initial hospitalization in a certain type of hospital is more or less likely to lead to a subsequent rehospitalization. Hospital characteristics that are accounted for in the regressions include ownership (voluntary, for-profit, public), teaching status, size, occupancy rate, and whether a hospital is located in an urban or rural area.

Finally, characteristics of the market in which the patient resides are incorporated into the regressions. These include (in addition to the demographic characteristics mentioned above) the physician-population ratio, the percentage of physicians who are specialists, the nursing home bed-population ratio and the percentage of the population enrolled in HMOs. Nursing homes may

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[5] See Noether, 1988, for an analysis that uses Medisgrps patient ratings to measure severity directly.

act as a substitute to rehospitalization, while HMOs are also predicted to cut down on utilization. Different physician demographics may reflect underlying differences in practice patterns.

The dependent variable in the beneficiary level regressions is a dummy variable taking the value of one if the individual is readmitted within a specified window of time following discharge (14, 30 or 60 days) and zero otherwise. Estimates are presented for each of the four tracer categories and for the file of general hospitalizations. Only live discharges (from the initial stay) are considered.

An appropriate statistical technique for analyzing the data is logistic regression which estimates the probability of being readmitted. Unfortunately, the size of the data sets used here (30 to 50 thousand observations) makes logistic techniques prohibitively expensive. The OLS techniques employed admittedly result in inefficient estimates. Moreover the R^2 statistic is invalid. Fortunately, the size of the data set should also lessen the problems encountered using dichotomous dependent variables.

b. Results - Beneficiary Level Regressions

Table 3 shows regression results for the PPS variables. The other results can be found in the Appendix.

1. Regulatory Variables

Table 3 depicts the coefficients on the PPS dummy and trend variables for each of the tracers and time windows. In

Table 3

Effects of PPS on Readmission Rate Implied by Beneficiary Regressions (as a percentage of the mean rate)

	Dummy Specification			Trend (Per Year) Specification		
	14	30	60	14	30	60
ALL READMISSIONS						
Hips						
Coefficient	.0128	.0164	.0209	.0058	.0080	.0120
t-statistic	2.63	2.83	3.13	2.78	3.23	4.17
Percentage effect	16.9	14.7	13.1	7.7	7.2	7.5
Readmission rate*	.0756	.1113	.1591	.0756	.1113	.1591
Hernia						
Coefficient	.0113	.0110	.0188	.0036	.0041	.0048
t-statistic	3.66	2.84	3.93	2.49	2.22	2.14
Percentage effect	31.5	18.8	20.2	10.0	6.8	5.2
Readmission rate	.0359	.0585	.0932	.0359	.0589	.0932
General						
Coefficient	.0130	.0150	.0229	.0058	.0065	.0094
t-statistic	2.90	2.77	3.75	2.83	2.62	3.36
Percentage effect	10.9	7.9	8.4	4.9	3.4	3.5
Readmission rate	.1188	.1907	.2711	.1182	.1907	.2711
Stroke						
Coefficient	.0242	.0192	.0134	.0048	.0046	-.0006
t-statistic	4.71	3.28	2.09	2.06	.17	-.20
Percentage effect	15.7	8.9	4.6	3.1	.2	-.2
Readmission rate	.1540	.2150	.2887	.1540	.2150	.2887
Pneumonia						
Coefficient	.0042	.0120	.0197	.0005	.0029	.0056
t-statistic	.99	2.37	3.41	.27	1.21	2.08
Percentage effect	3.8	6.8	7.7	.4	1.6	2.2
Readmission rate	.1108	.1763	.2551	.1108	.1763	.2551

*dependent variable mean

	Dummy Specification			Trend (Per Year) Specification		
	14	30	60	14	30	60
READMISSIONS DUE TO COMPLICATIONS						
Hips						
Coefficient	.0040	.0085	.0121	.0008	.0028	.0039
t-statistic	1.32	2.39	3.07	.62	1.84	2.33
Percentage effect	17.0	25.3	29.1	3.4	8.3	9.4
Readmission rate	.0235	.0336	.0416	.0235	.0336	.0416
Hernias						
Coefficient	.0015	.0024	.0044	.0002	.0008	.0016
t-statistic	1.06	1.44	2.15	.31	1.02	1.68
Percentage effect	22.7	25.0	30.8	3.0	8.3	11.2
Readmission rate	.0066	.0096	.0143	.0066	.0096	.0143

addition, the relative effect, measured as the ratio of the coefficient to the mean of the readmission dummy used as a dependent variable (times 100), is shown. The mean of the dependent variable can be viewed as the global probability across all years, types of beneficiaries, hospitals and markets, of being readmitted within the indicated time window. It is evident from Table 3 that the effect of PPS on the probability of readmission is generally positive but varies in magnitude substantially across tracer categories and specifications. The surgical tracers, hip replacements and hernia repairs, appear to show the largest impacts, as was suggested by the raw data. The strongest effect appears to occur within 14 days of discharge for the general set of discharges as well as for all tracers, except for the pneumonia tracer where the effect increases as the length of the window widens.

One would expect the effect of the TEFRA program to be similar, but perhaps smaller than that of PPS. A dummy variable measuring the TEFRA year equals one for the year prior to the time a hospital came under PPS, and one during 1983 for hospitals in waivered states. While this causes some error since some hospitals changed their fiscal years in order to delay implementation of PPS, it is the best approximation possible. In general, the coefficients on the TEFRA variable are less significant than those on the PPS measure, and are generally insignificant by normal statistical benchmarks. In those cases where the effect is positive (all the pneumonia and stroke coefficients, as well as the hip replacement coefficients in the PPS dummy variable regressions) the magnitudes of the coefficients suggest smaller effects than PPS, as predicted.

2. Hospital Characteristics

Hospital ownership (voluntary non-profit, proprietary, or public) does not seem to affect the probability of readmission strongly or consistently. For-profit status is associated with higher pneumonia, stroke and general readmission rates than is private non-profit ownership, but is related to lower readmission rates for the surgical tracers. It is never significant at any reasonable level, however. An initial stay in a public hospital appears to result in readmission more frequently than does a stay in a private, non-profit hospital, but the effect is only significant for the pneumonia tracer group.

Two categories of teaching hospitals, minor teaching and major teaching, are compared to non-teaching hospitals with mixed results. No consistent pattern emerges across the minor-teaching hospital coefficients. Major teaching hospitals appear to be more frequently associated with readmission for the non-surgical and general admission categories, but the effect is not always significant.

Rural hospitals are associated with significantly higher readmission rates than their urban counterparts for stroke and pneumonia cases. The coefficients for these two tracers suggest readmission rates that are 5-9 percent higher (relative to the mean rate) than for urban hospitals. For the surgical and general tracer categories, no significant effect of location appears.

Except for the pneumonia readmission regressions, a hospital's occupancy rate seems to be systematically negatively related to the readmission of patients discharged from it. This finding has at least two interpretations. First, higher quality hospitals may both have higher occupancy rates and generate fewer readmissions. In this case the occupancy rate, itself, has nothing to do with the probability of readmission, but both occupancy rates and readmission probabilities are related to the quality of care given at the hospital. Second, low occupancy rates may cause hospitals to try to increase admissions; one way of increasing readmissions is to try to cause patients who are discharged to be readmitted. If this latter theory is correct, then a dependent variable that considers only the probability of readmission to the **same** hospital (recall that the current specification includes readmission to any hospital within the time window) should show a stronger effect.[6]

Hospital size affects the probability of readmission for some tracers, but the pattern varies considerably across tracers. In all cases where a significant coefficient does exist, it implies that initial stays in smaller hospitals are more likely to be associated with subsequent readmissions. For the surgical tracers there appears to be no size affect. For stroke cases, hospitals with fewer than 200 beds appear to have a significantly higher readmission rate. For pneumonia cases, all of the dummy variable coefficients are significant, but they decrease in size as the size of the hospital increases, suggesting an almost linear relation between size and readmission rates. Finally, the general file suggests that only the smallest hospitals, those with fewer than 50 beds, have above-average readmission rates. Given the diverse pattern across the four tracers, this last finding is perhaps not surprising.

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[6] Time has not permitted checking this hypothesis; however over 80% of all rehospitalizations in the sample are to the same hospital.

3. Patient & Stay Characteristics

As discussed above, the duration of a patient's initial stay may affect the probability of being readmitted either positively or negatively. It is feared by policy makers that the trend toward shorter stays in recent years has led to increased readmissions. This would suggest a negative relation between length of stay and the probability of being readmitted.

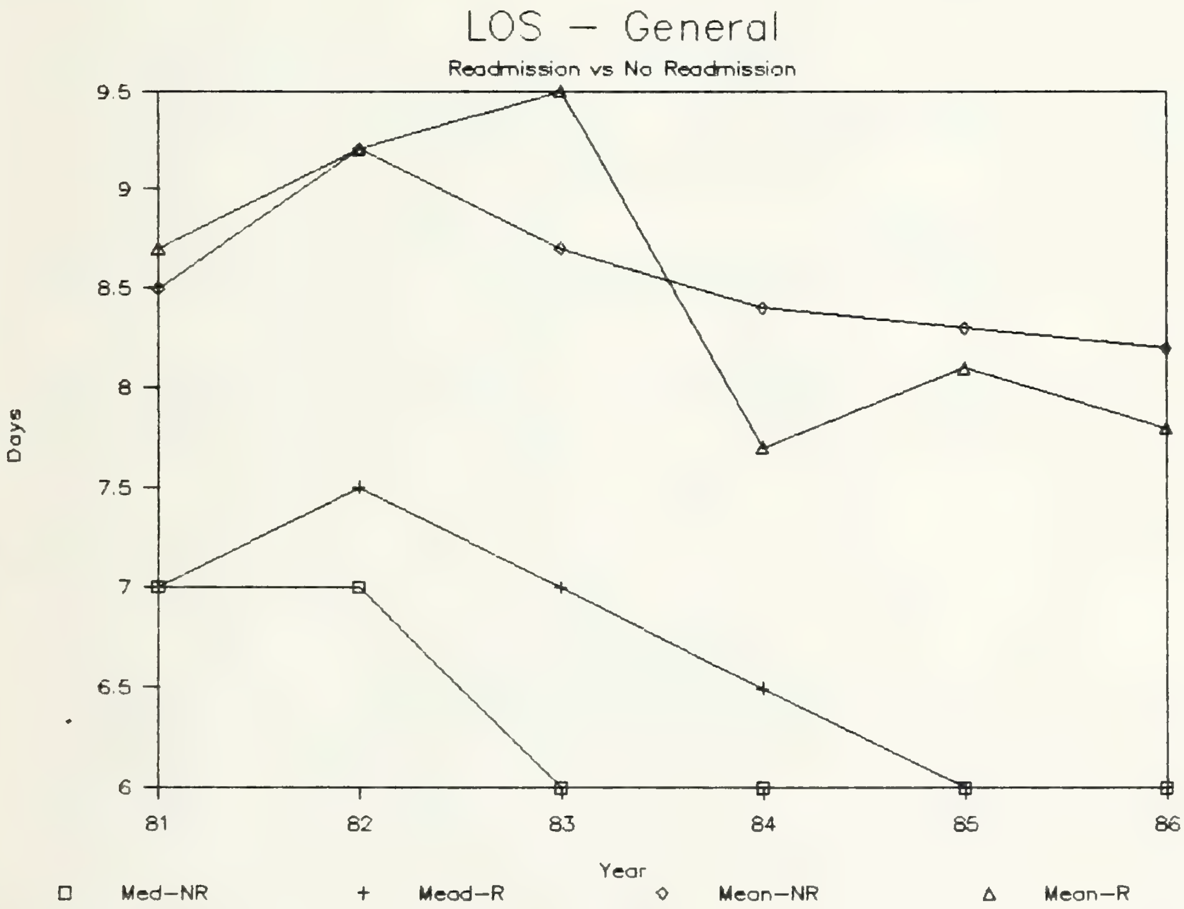
If, on the other hand, a positive relation is uncovered, at least two explanations are possible. First, shorter stays may be prevent some of the problems associated with lengthy hospitalization. Alternatively, if it is impossible to control completely for severity of illness, then length of stay may proxy for patient severity, and an estimated positive relation between length of stay and readmission may imply nothing more than that both are associated with more complex cases. Attempt has been made to control for patient severity through various other measures (described below) of the care received during the patient stay, but the control may be incomplete. Simple trends in the data suggest that the relation between length of stay and readmission rates is positive. Figures 2a-2e show the trends in median and mean length of stay between 1981 and 1986 separately for patients who were and were not subsequently readmitted. In general those patients who were subsequently readmitted to the hospital had a longer initial length of stay. However, the difference between initial lengths of stay for patients who are and are not readmitted declined over time for most categories. This pattern suggests that length of stay and readmission are positively related, but the relation is weakening over time.

Length of stay is entered in the regressions with both a linear and a quadratic term to allow non-linearities in the relation if, for example, patients with very long stays are systematically different than others. When the coefficients are significant, the linear length of stay measures appear to be positive while the quadratic terms are negative. This is true for the pneumonia, hernia, hip (except for 14 day window), and general categories. In all cases, the coefficient on the linear term is sufficiently larger than that on the quadratic that the combined effect on the probability of readmission is positive for all reasonable values of length of stay. These results imply that it is inappropriate to associate shorter lengths of stay with increases in the rate of readmission. Stroke cases appear to exhibit no significant relation between length of stay and

FIGURE 2

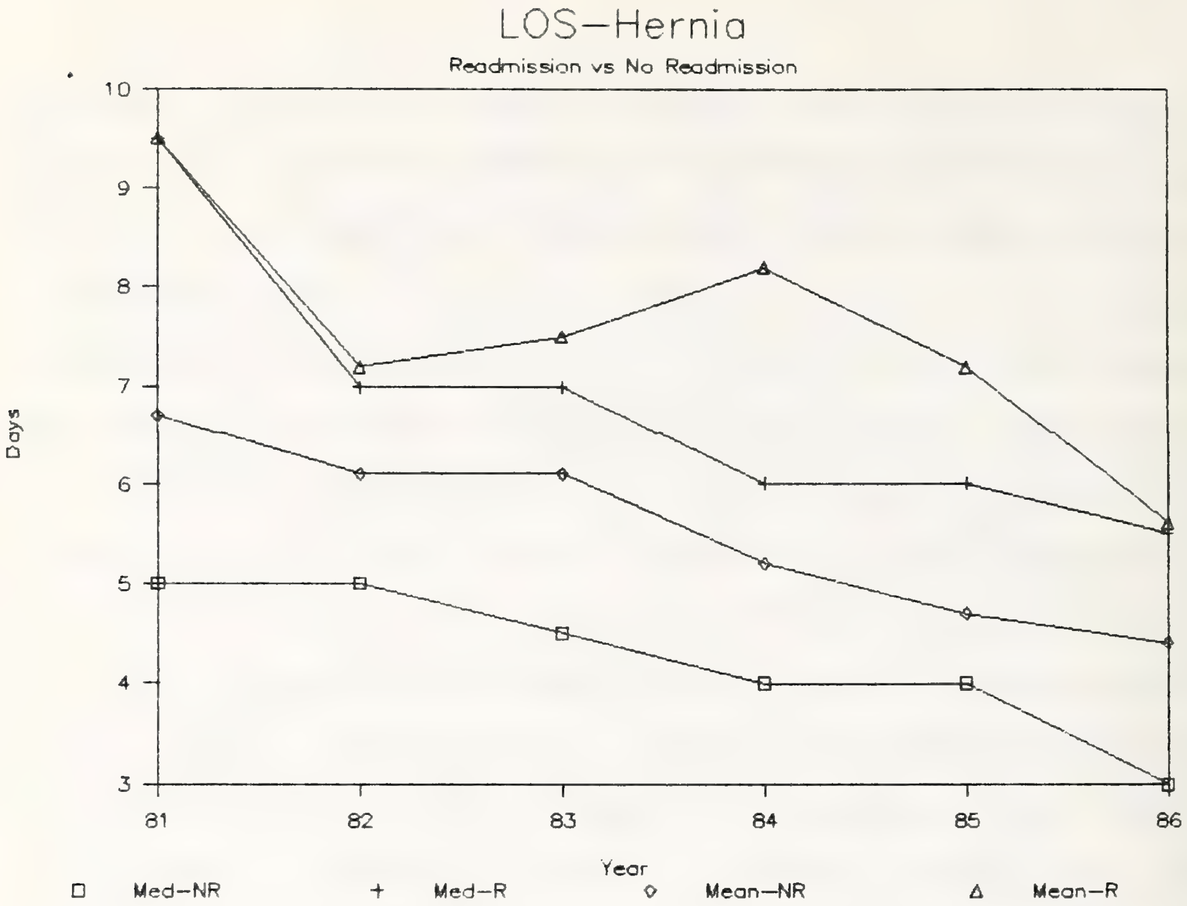
MEAN AND MEDIAN INITIAL LENGTH OF STAY

READMITTED VS NON-READMITTED PATIENTS



Med-NR: Median LOS of patients with no readmission in 60 days
Med-R: Median LOS of patients with readmission in 60 days
Mean-NR: Mean LOS of patients with no readmission in 60 days
Mean-R: Mean LOS of patients with readmission in 60 days

Figure 2 (cont)



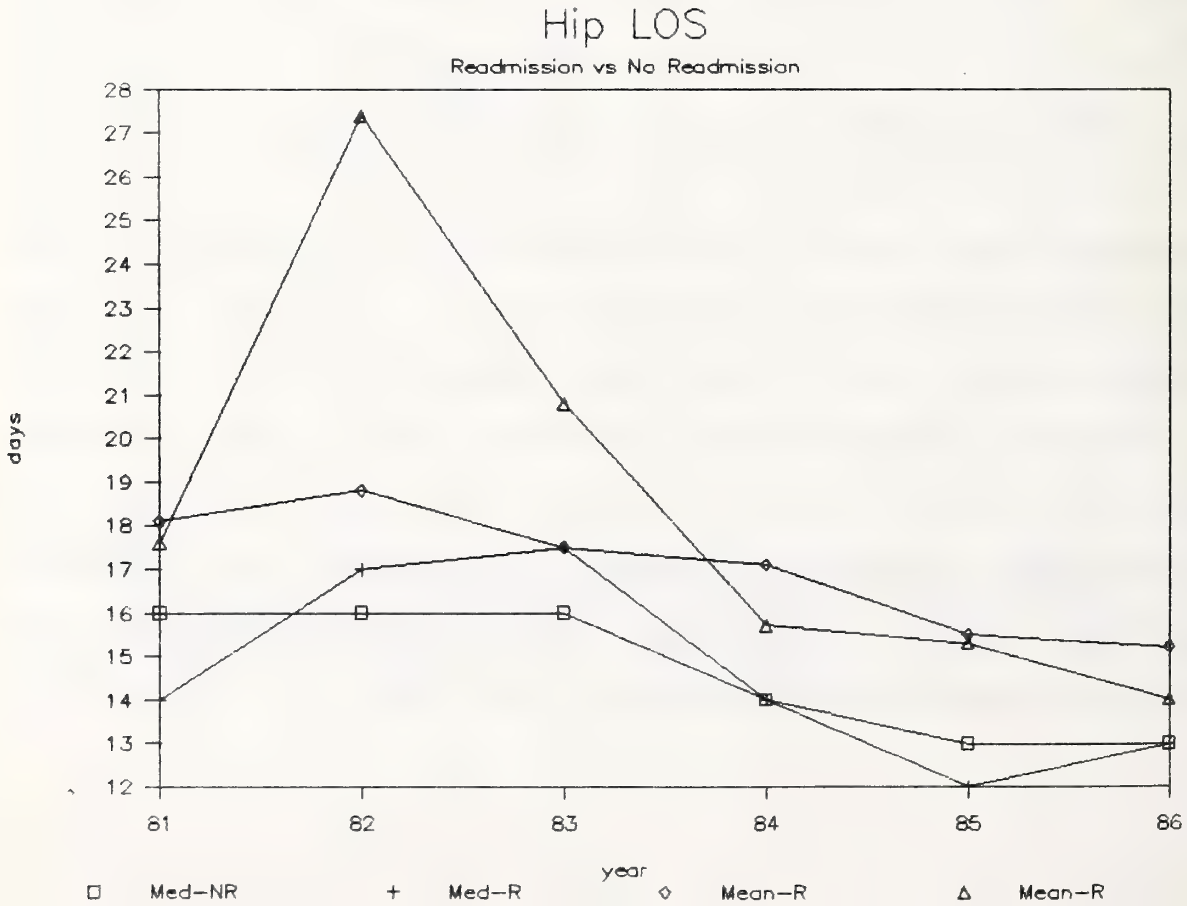
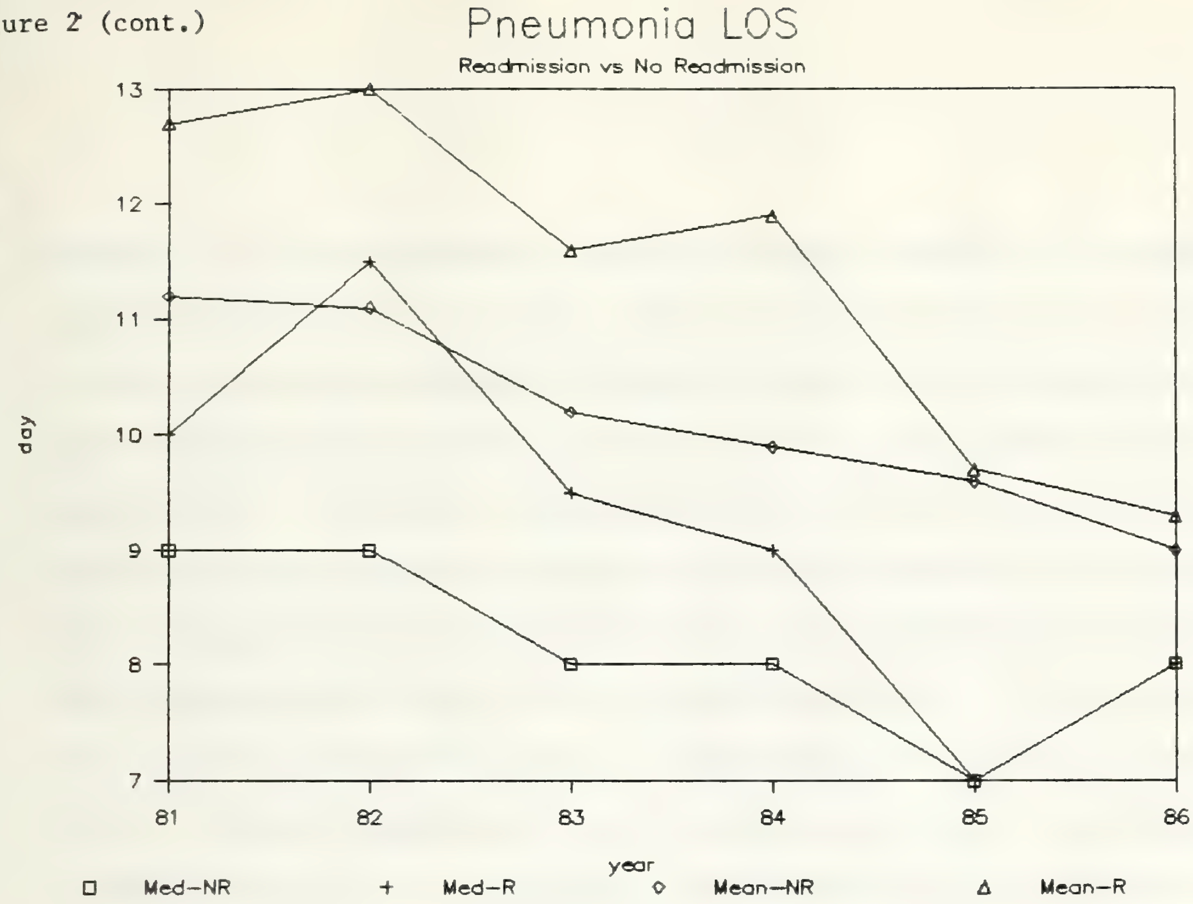
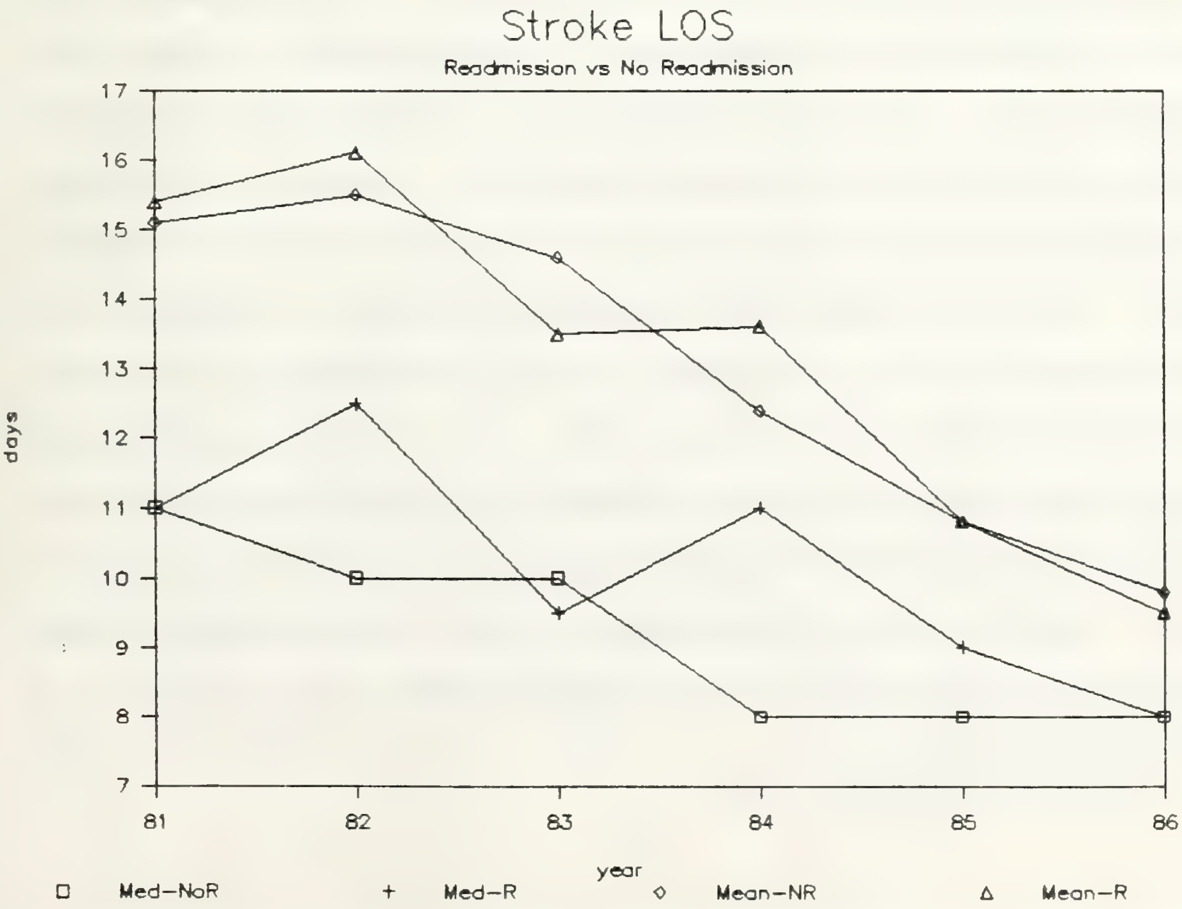


Figure 2 (cont.)



Pneumonia LOS

Readmission vs No Readmission



Stroke LOS

Readmission vs No Readmission

readmission, although most of the coefficients, on both the linear and quadratic terms are negative. Further work will explore the interaction of a "PPS effect" with length of stay.

Other work that uses Medisgrps ratings of patient severity to control for case mix differences (Noether, 1988) finds a strong relation between admission severity and length of stay for pneumonia and stroke cases, but not for hip replacement cases. In addition, a moderate relation is found between discharge severity and the probability of being readmitted, again for pneumonia and stroke but not for hip replacement cases.

Surgical stays may suggest a greater or lesser degree of severity and probability of readmission than non-surgical stays. The proportion of Medicare hospital stays that involve surgery increased dramatically, from 31% in 1981 to 56% in 1986.[7] If surgical stays are associated with different rates of readmission than non-surgical stays, it is important to account for which beneficiaries undergo surgery in attempting to isolate PPS effects on readmission rates. It is difficult to predict whether surgery is likely to increase or decrease the probability of readmission. While various post-operative complications may increase the likelihood of readmission, it is also possible that surgical patients are, on average, otherwise healthier and therefore less prone to general complications. It is true, as figure 1 showed, that the readmission rates are lower for the two surgical tracers studied than they are for the non-surgical tracers. The regressions contain two variables to measure the effect of surgery. For the non-surgical tracer categories (stroke, pneumonia, and general) a dummy variable denotes the existence of any surgery during the stay. This variable is not included in the hip replacement and hernia repair regressions since all the cases are surgical. A second dummy variable indicates the presence of additional surgery (beyond any initial additional surgery) within the initial stay. This variable is used for all five categories. Presumably, this variable suggests greater patient severity relative to those cases with just one surgery, but it is not clear how people with multiple surgeries compare to those with none.

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[7] Abt BEAA - Quarter File.

The surgical dummy variable appears to have a strong negative impact on the probability of readmission for the general and stroke regressions. The effect on pneumonia cases is positive but substantially weaker and less significant. The additional surgery variable is positive for all except the pneumonia cases, but is generally not a powerful explanator of readmission rates. Hernia repair is the one tracer that seems to show a consistently strong positive effect of additional surgeries on readmission. Since hernia repair is a relatively simple procedure and the average casemix is correspondingly low, additional surgery may be a strong indicator of a patient of above-average severity.

Intensive or coronary care use is expected to be associated with more severely ill patients and, therefore, have a positive effect upon the rate of readmission. In fact, this is universally true.

Additional hospital stays within some period of time prior to the hospitalization studied may suggest chronic utilization of the hospital. In this case, readmissions following the "initial" hospitalization used to define the episode of care may be part of a pattern of frequent usage and not suggest complications from a particular stay. Some concern might be warranted if rates of prior usage had increased since the enactment of PPS, but they remained relatively constant over the 1981-1986 time period analyzed.[8] The variable used in the regressions is the number of days a beneficiary spent in the hospital during the 60 days prior to the hospitalization in question. The variable has a universally positive and highly significant effect on the probability of readmission, suggesting that chronic use of the hospital is an important determinant of rehospitalization.

4. Market Characteristics

Market characteristics, defined for the county of the beneficiary´s residence, have some influence on the readmission rate as well. While per capita income does not tend to matter in any consistent fashion, median years of education has a universally negative effect on the probability of readmission. The percentage of the population enrolled in HMOs has a surprisingly positive effect on the probability of readmission. The variable, however, reflects a population-wide average which is not necessarily highly correlated with the percentage applicable to the Medicare population and certainly does not indicate whether the beneficiary in question is enrolled in an HMO. Additionally, it has been suggested that HMOs initially became strongest in areas that needed utilization review the most. Given this fact, the finding is not surprising. The nursing home bed-population ratio has a generally negative, albeit not highly significant effect on readmissions. Access to nursing home care may substitute for rehospitalization. Finally, the physician-population ratio does not have a significant effect on the probability of readmission, but holding constant the total physician-population ratio, the percentage of physicians who are specialists is negatively related to readmissions. One interpretation of this finding is that specialists provide better care during the initial stay.

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[8] Abt BEAA Quarter File.

c. Results - Hospital Level Regression

At the hospital level one can examine the determinants of a hospital's rate of readmission, i.e. the proportion of all live discharges who are readmitted within a certain time period. The regression reported describes the readmission rate within 30 days of discharge. This level of analysis allows a more careful focus on how the characteristics of a hospital affect its rate of readmission. Variables similar to those included in the beneficiary level regressions are used as well, although they are hospital-wide averages. Regressions are not reported for the

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                                                                                   12:07 TUESDAY, SEPTEMBER 6, 1988   1
Hospital File - 30 Day Readmission Rate

                       SUM OF         MEAN
SOURCE      DF        SQUARES       SQUARE       F VALUE      PROB>F

MODEL       32      16.507022     0.515844       127.268      0.0001
ERROR     6091      24.688108  0.004053211
C TOTAL   6123      41.195130

    ROOT MSE         0.063665     R-SQUARE        0.4007
    DEP MEAN         0.187487     ADJ R-SQ        0.3976
    C.V.               33.957

                    PARAMETER     STANDARD    T FOR H0:                      VARIABLE
VARIABLE   DF        ESTIMATE        ERROR  PARAMETER=0    PROB > !T!         LABEL

INTERCEP    1        0.191840     0.017545       10.934        0.0001  INTERCEPT
CMI         1       -0.041659  0.007331872       -5.682        0.0001
ICCU        1        0.043605     0.013027        3.347        0.0008
LOS         1     -0.00136227 0.0003469639       -3.926        0.0001
SS          1       -0.029486   0.00496467       -5.939        0.0001
PREUSE      1        0.598288     0.010990       54.440        0.0001
WAIV_DUM    1     0.002592337  0.003977612        0.652        0.5146
PPS         1     0.006921455  0.006957986        0.995        0.3199
TEF_DUM     1     0.006632405  0.006781515        0.978        0.3281
TREND       1      0.00107572 0.0002892524        3.719        0.0002
PPSTREND    1    -0.000558086 0.0004541256       -1.229        0.2191
OCCRATE     1     0.004285682  0.007195429        0.596        0.5515
SIZE1       1        0.041516  0.004866333        8.531        0.0001
SIZE2       1        0.027011  0.004183624        6.456        0.0001
SIZE3       1        0.015098  0.003798282        3.975        0.0001
SIZE4       1        0.011646  0.003591899        3.242        0.0012
SIZE5       1        0.014898  0.004741494        3.142        0.0017
RURAL       1     0.002468264  0.002544955        0.970        0.3322
CTYEMP5K    1        0.125767     0.092806        1.355        0.1754
TCH2        1     -0.00181887  0.002763168       -0.658        0.5104
TCH3        1        0.018141  0.006057096        2.995        0.0028
PROF        1      -0.0063392  0.002697909       -2.350        0.0188
GOV         1     -0.00309823  0.002196576       -1.410        0.1584
Q1          1    -0.000840244  0.002390724       -0.351        0.7253
Q2          1      -0.0011297  0.002382943       -0.474        0.6355
Q3          1     -0.00116144  0.002383127       -0.487        0.6260
CAPINC      1    -0.000886285 0.0006095148       -1.454        0.1460  MEAN PER CAPITA INCOME (TEBI)
HMOPOP      1    0.0002479037 0.0001282295        1.933        0.0532  % OF POP ENR IN HMO (SMSA OR COUNTY)
EDUC        1     -0.00395251  0.001153916       -3.425        0.0006  MEDIAN SCHOOL COMPLETED IN 1970
WHITEPCT    1    -0.000152584 .00007121054       -2.143        0.0322  % OF POPULATION THAT IS WHITE
PHYSPOP     1    -.0000636584 .00001373278       -4.636        0.0001  PATIENT CARE DRS. PER 100K POPULATION
SPMDPCT     1    -0.000004433 .00005159435       -0.086        0.9315  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
POPDENS     1     3.60063E-07  1.96958E-07        1.828        0.0676  POPULATION DENSITY (P/LANDAREA)
```

readmission rates of individuals initially admitted in the four tracer categories. Unfortunately numerous hospitals have no or very few patients in each of the tracers in any given quarter which makes the measured readmission rates fluctuate widely from quarter to quarter. This renders the results fairly meaningless.

Since the hospital data set contains a time series of data for each hospital, changes over time are measured in a slightly different way from the beneficiary file where dummy variables captured the effect of a given stay occurring in a hospital currently under PPS or TEFRA. Here we include a time trend that begins in the first quarter of 1981 and increases through 1986. In addition a PPS dummy variable equals one in all quarters following the time that a particular hospital came under PPS, which depended on its fiscal calendar. Finally, the PPSTREND variable interacts the PPS dummy and the linear trend to allow the PPS time period to have its own trend. The estimated net effect of the three variables suggests that the impact of PPS on the readmission rate was positive. By the third quarter of 1986, the estimate increase in readmissions was 10.3 percent from 1980 levels. The largest and most significant contribution, however, comes from the linear trend variable which suggest that much of the increase in the readmission rate is not attributable to PPS, ut rather is due to an unexplained (by all the other variables in the regression) trend. Since it is difficult to determine what might be causing the trend, it is impossible to reach strong conclusions without further analysis. The TEFRA dummy suggests a positive but insignificant effect. Hospitals in waivered states show no difference from hospitals under PPS in their readmission rates.

As in the beneficiary level regressions, hospital size appears to be negatively related to the readmission rate. In this regression, the pattern is almost linear. Major teaching hospitals appear to have higher readmission rates. Ownership does not appear to matter. Occupancy rate also does not appear to matter, perhaps because many missing values, particularly in the later years, were filled in with the yearly averages, so that the variable is measured with considerable error. Rural hospitals may have a somewhat higher readmission rate, but the coefficient on the rural dummy variable is not highly significant.

Average patient characteristics appear to explain more of a hospital's readmission rate. The percentage of patients receiving intensive or coronary care during their initial stay positively affects the readmission rate as does the percentage of patients who have been hospitalized within the previous 30 days.[9] The higher the proportion of surgical stays, the lower the readmission rate. Interestingly, length of stay also has a negative relation to the readmission rate. This finding conflicts with that found in the beneficiary level regressions and needs further analysis before it can be reconciled with those findings. Possibly, the average values in the hospital files abstract from some of the case mix measurement problem found at the beneficiary level. If the finding from the hospital file is correct, it does appear that shorter lengths of stay may be related to an increased probability of readmission. Strangely, the case mix index also has a negative effect on readmissions.

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[9] This latter variable is by far the most significant in the regression, again suggesting a chronic user phenomenon.

Market characteristics (of the county in which the hospital is located) are also included in the regressions. The physician-population ratio has a negative effect on the readmission rate, holding constant population density and the proportion of physicians who are specialists. This may suggest that patients receive better care during their initial stays in areas where more physicians exist, or perhaps physicians tend to practice in areas where the hospitals are of higher quality. As in the beneficiary level regressions, areas with a greater percentage of the population enrolled in HMOs may have a higher readmission rate as do areas where a greater percentage of the population works for large companies (which may exert more control over their health care costs), but neither effect is very significant. More educated populations tend to be readmitted less frequently.

5. Readmission Rates due to Complications

As discussed earlier, rehospitalizations can occur for many reasons. Policy makers have been primarily concerned about the potential effect of prospective reimbursement on one type of readmission: those due to complications arising from inappropriate or inadequate care during the initial hospital stay. In this section of the paper we examine trends in select readmission diagnoses to attempt to focus on this one type of readmission.

Little published research exists that distinguishes between appropriate and inappropriate readmissions. Roos et al. (1985) is one exception. That article used data from the Canadian Health Services Commission to identify readmissions due to complication following hysterectomy, cholecystectomy and prostatectomy procedures. The paper is largely descriptive.

Readmissions following two surgical procedures, total hip replacement and inguinal hernia repair, are examined here. The analysis is limited to these two tracers because complications arising from surgical procedures are easier to categorize than those from general diagnostic care. Pneumonia, for example, is often itself a complication to other illnesses or procedures, so that it is difficult to determine what complications might arise from pneumonia and whether a given episode of pneumonia is or is not itself a complication.

Determining the list of diagnoses (classified by ICD-9 codes) that are thought to be indicative of complications of hip replacements or hernia repairs was a multi-step process. A broad list of all ICD-9 codes that might be indicative of complications to each procedure was derived in consultation with a staff physician. In addition, frequencies were examined over the entire six years of data for all primary diagnoses upon readmission for the hip replacement, hernia repair and general files. Those procedures thought possibly to be complications were examined and were retained on the list if over the six year period as a whole if they met the following criterion. Their frequency had to be substantially (at least double) greater for the tracer category for which they were thought to be a complication than for the general category or for the other tracer.

A few other diagnoses not on the original list, e.g. hyperplasia of the prostate following hernia repair or osteoarthritis following hip replacement, appeared with a sufficiently large frequency during the readmission to be unattributable to chance. These diagnoses, however, are more likely to lead to the need for a hip replacement or hernia repair than to be caused by such a procedure, and therefore were not included among the complication diagnoses. For a couple of diagnoses, the direction of causation is not medically obvious. In these cases, we omitted those cases where the diagnosis was present not only upon the readmission but also upon the initial admission.[10]

Patients who had been hospitalized within 60 days of the base admission (for the surgical procedure) were also omitted for the analysis of complication diagnoses. While the best approach would have been to delete only those cases where the previous admission was also for one of the complicating diagnoses, since diagnostic information on prior utilization was unavailable, the most conservative strategy appeared to be to delete all cases with prior usage.

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[10] These codes include 788.2 and 835.0 for hip replacement patients.

The resulting diagnoses of complications for hip replacements and hernias are listed below, and are referred to as "complication diagnoses" in the following discussion.

Hip Replacement Complications	ICD-9 Codes
Volume Depletion	276.5
Pulmonary Embolism	415.1
Phlebitis & thromobophlebitis	451
Urinary Tract Infection	599.0
Cellulitis, buttock	682.5
Cellulitis, leg	682.6
Decubitus Ulcer	707.0
Ulcer of lower limbs, other	707.1
Retention of Urine	788.2
Closed Dislocation of Hip, unspecified	835.00
Complication: Internal Orthopedic Device	996.4
Complication: Other Prosthetic device	996.5
Complication: Infection due to internal prosthetic device	996.6
Complication: Other, or internal prosthetic device	996.7
Peripheral vascular complication	997.2
Respiratory Complication	997.3
Other complication, not elsewhere classified	998

Hernia Repair Complications	ICD-9 Codes
Pulmonary Embolism	415.1
Hernia of Abdominal Cavity	550-553
Peritonitis	567
Hematuria	599.7
Cellulitis of the Trunk	682.2
Other Complication, not elsewhere classified	998

Table 4 shows the percentage of all patients initially admitted to the hospital for a hip replacement or hernia repair

Table 4

Trends in Readmission Rates Due to Complication for First Readmission by Diagnosis

INITIAL HOSPITALIZATION FOR HIP REPLACEMENT

Primary Readmission Diagnosis (ICD-9)	1981		1982		1983		1984		1985		1986	
	#	%	#	%	#	%	#	%	#	%	#	%
276.5	6	.23	3	.08	13	2.92	14	.29	11	.21	8	.20
415.1	13	.51	14	.39	23	5.17	16	.33	21	.40	16	.39
451	10	.39	15	.42	12	2.70	17	.35	19	.36	14	.34
599.0	5	.19	11	.31	11	2.47	20	.41	23	.44	13	.31
682.5	0	--	0	--	1	.02	0	--	0	--	0	--
682.6	1	.03	1	.03	5	.11	5	.10	6	.11	2	.05
707.0	1	.03	5	.14	2	.04	9	.18	4	.08	6	.15
788.2	0	--	1	--	0	--	1	.02	3	.06	0	--
835.0	7	.27	18	.50	21	.47	13	.27	8	.15	4	.10
996.4	21	.82	24	.67	50	1.12	59	1.20	75	1.42	56	1.37
996.5	2	.08	2	.06	10	.22	10	.20	15	.28	7	.17
996.6	3	.12	2	.06	4	.90	7	.14	2	.04	8	.20
996.7	3	.12	5	.14	4	.90	7	.14	10	.19	5	.12
997.2	1	.03	0	--	0	--	3	.06	5	.09	6	.15
997.3	0	--	0	--	1	.02	0	--	5	.09	1	.02
998	5	.19	3	.08	12	2.70	19	.39	19	.36	23	.56
Total	78	3.04	104	2.91	169	3.80	200	4.08	226	4.29	169	4.14

INITIAL HOSPITALIZATION FOR HERNIA REPAIR

415.1	2	.06	4	.09	3	.06	10	.18	4	.08	4	.12
550	18	.53	41	.93	38	.71	41	.73	24	.49	26	.76
551	0	--	0	--	0	--	0	--	0	--	0	--
552	1	.03	0	--	1	.02	1	.02	0	--	0	--
553	2	.06	7	.16	6	.11	4	.07	3	.06	1	.03
567	0	--	0	--	1	.02	0	--	2	.04	0	--
599.7	0	--	1	.02	3	.06	0	--	2	.04	1	.03
682.2	0	--	0	--	2	.04	1	.02	2	.04	0	--
998	5	.15	10	.23	16	.30	27	.48	32	.66	31	.90
Total	28	.82	63	1.42	70	1.31	84	1.49	69	1.41	63	1.84

who are subsequently readmitted within 60 days with the listed diagnoses for each year between 1981 and 1986. It appears that the aggregate frequency of readmission due to complication, for both hip and hernia discharges, has increased, although there is a large variation across different diagnoses. Moreover, from the simple time series, it is not obvious that any increase is attributable to PPS. Rather an upward trend appears to prevail throughout the period. Table 5 shows the aggregate trends for the subsequent readmissions and also depicts the trends in 7, 14, 30 and 60 day readmission rates,[11] as well as the frequency of readmission for a complicating diagnosis classified by various hospital and patient characteristics. No strong differences across hospital or patient types are evident.

Regressions identical to those specified on overall readmissions[12] were also run on those readmissions attributable to complicating diagnoses. Table 3 also shows the percentage effects as measured by the PPS variables for these regressions. The discussion below focuses on the differences between the two sets of regressions.

For the 30 and 60 day windows, the increase in the

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[11] The sum of the first, second, and third readmission diagnoses does not necessarily add up to the 60 day readmission rate because some people are readmitted more than once for a complicating diagnosis. Only the second readmission is listed for hernia repair patients because the number of patients with a third readmission is trivial.

[12] The one difference is that those individuals with hospital utilization in the 60 days prior to their base admissions are omitted from the sample in these regressions.

TABLE 5

TRENDS IN READMISSION RATES DUE TO COMPLICATIONS

	1981	1982	1983	1984	1985	1986
Readmission Rate* for complicating primary diagnosis						
Hip Replacements						
First Readmission	3.0	2.9	3.8	4.1	4.3	4.1
Second Readmission	.4	.4	.6	.6	.9	.9
Third Readmission	.1	0	.2	.1	.1	.2
Hernia Repair						
First	.8	1.4	1.3	1.5	1.4	1.8
Second	0	0	.1	.1	.1	.2
Readmission Rate within n Days of Discharge						
Hip Replacements						
7 Days	1.4	1.3	1.6	1.6	1.7	1.6
14 Days	1.7	1.8	2.4	2.5	1.8	2.6
30 Days	2.3	2.7	3.4	3.5	3.8	3.9
60 Days	3.3	3.2	4.1	4.4	4.7	4.8
Hernia Repair						
7 Days	.2	.3	.3	.5	.5	.6
14 Days	.3	.5	.5	.8	.7	1.1
30 Days	.5	.9	.8	1.1	1.0	1.5
60 Days	.9	1.5	1.4	1.6	1.4	2.0

*The percentage of people initially admitted to undergo a hip replacement (or hernia repair) who are subsequently readmitted within 60 days with a primary diagnosis indicating a complication

60-Day Readmission Rate by Hospital Characteristics

Urban-Rural

	Urban	Rural
Hip Replacements	4.1	4.3
Hernia Repair	1.4	1.5

Bed size

	<50	50-99	100-199	200-299	300-399	>400
Hip Replacements	4.6	4.3	4.4	4.1	3.9	4.1
Hernia Repair	1.6	1.6	1.5	1.5	1.4	1.4

Ownership

	Non-Profit	Proprietary	Public
Hip Replacement	4.1	4.3	4.1
Hernia Repair	1.3	1.6	1.9

Teaching Status

	None	Minor	Major
Hip Replacement	4.3	4.1	3.6
Hernia Repair	1.5	1.3	1.8

60-Day Readmission Rates by Patient Characteristics

Age

	<65	65-79	>80
Hip Replacement	4.8	3.9	4.6
Hernia Repair	2.6	1.3	1.6

Intensive/Coronary Care Use

	No	Yes
Hip Replacement	4.1	4.8
Hernia Repair	1.5	1.5

complication readmission rate since PPS seems to be somewhat larger than for all readmissions. Conversely, the rate at 14 days appear to be lower. This may imply that there has been a greater increase over time in the types of diagnoses classified as complications which take longer to manifest themselves than does the average diagnosis leading to readmission. The PPS effect also appears to be less significant for complication diagnoses than for all readmissions, especially for hernia cases.

Differences in the hospital variable effects are small and probably insignificant. Several differences, however, are evident for the patient characteristics. Most notable is the effect of length of stay. In the hip replacement regressions, the linear (and aggregate) measure of length of stay is negative in the complication diagnosis regressions, implying that earlier discharges are more likely to be readmitted due to a complication. It is still difficult to determine whether the earlier discharge actually causes the readmission or whether during longer stays, complications occur during the initial stay. In the hernia repair regressions, the total effect of the linear and quadratic terms remains positive, but the effect becomes much smaller in magnitude (and significance). This suggests that patient severity is less a determinant of complication regressions and/or that the problems associated with longer stays do not manifest themselves in complication readmissions.

Intensive and coronary care use during the initial stay also is not as strongly correlated with subsequent readmission for complication diagnoses. The magnitude of the effect becomes much smaller and less significant for hip replacement cases and becomes negative and totally insignificant for hernia repairs.

These findings suggest that patient severity during the initial stay is not related as strongly to subsequent readmissions for complications as it is to readmission in general. This is not surprising if the complications are, at least to some significant extent, avoidable "bad" outcomes of an initial stay and do not represent chronic use of the hospital.

The analysis of complication readmissions is obviously preliminary, but the initial results suggest that further work is warranted. Interesting questions arose during the process of determining which readmission diagnoses and cases were appropriately labeled as complications resulting from surgery or other care received during the initial stay. For example, as mentioned earlier, it is relatively common to observe males who undergo a hernia repair during their initial stay readmitted for prostate problems of either a benign or malignant nature. Diagnostic and therapeutic surgical procedures, such as a cystoscopy or transurethral resection of the prostate (TURP) are sometimes performed upon the readmission. Since it is likely that the prostate problem led to the need for a hernia repair, it is interesting that it was not taken care of prior to or during the hernia admission. At least two explanations are possible. One is that if the hernia problem was more urgent, it was appropriate to treat it first, and some time period for recovery was necessary before submitting the patient to a second surgical procedure. Another possibility is that hospitals are acting on a PPS-induced incentive to split hospital stays that are appropriately single admissions into multiple admissions to maximize reimbursement.

Another question arising from this analysis is the timing of the complication. Analysis of the initial admissions reveal that they sometimes also show a diagnosis clearly indicating a complication from a surgical procedures. It is possible that when lengths of stay were longer, complications were arising during the initial stay instead of resulting in a readmission. Therefore the overall rate of complications may not have increased, only the number of readmissions due to complications may have risen.

Questions such as these suggest that further analysis of surgical complications is warranted. A thorough analysis requires examination of the timing of all of the surgical procedures as well as all the diagnoses associated with an episode of care involving multiple admissions to the hospital. Merely selecting patients on the basis of a tracer surgical procedure performed in a single admission masks a variety of differences in underlying disease patterns and treatment regimes across patients.

6. Transfers to Other Hospitals

Another potential effect of PPS is patient transfer. Since the payment for each diagnosis is limited, there may be incentive to transfer cases which are expected to be expensive. Ansell and Schiff (1987) cite evidence that the rate of transfers increased in several major cities during the early 1980s. DesHarnais et al. (1987) found the observed transfer rate of Medicare patients in 1984 was 1.46% which was significantly higher than the predicted rate of 1.04% had PPS not been in effect.

Table 6 shows the frequency of transfers for each of the tracer diagnoses and the general category over the last 6 years. It is evident from these numbers that no significant increase in the rate of transfer has occurred since the enactment of PPS in any of the disease categories.

Table 6 also shows the frequency of transfers from hospitals with various characteristics. The hospital that is most likely to transfer patients to another facility is small and rural and has a low occupancy rate. Teaching hospitals and private non-profit hospitals appear to have lower transfer rates than non-teaching or public hospitals. Transfer rates over time for hospitals with various characteristics have also not changed significantly. These findings suggest that the fear that numerous costly patients are being "dumped" into the low quality hospitals as a result of PPS is unfounded. While the lack of information on the destination of transfer patients prevents definitive conclusions, the leading sources of such patients

Table 6

Transfer Rates Over Time and By Hospital Characteristics

TRENDS

YEAR	81	82	83	84	85	86
General	2.2	2.1	2.1	2.2	2.2	2.3
Pneumonia	1.4	1.5	1.5	1.4	1.2	1.3
Stroke	4.8	5.3	5.5	5.2	4.5	5.0
Hernia	.1	.3	.3	.2	.2	.3
Hip Replacement	1.6	1.5	1.6	1.4	1.0	1.3

HOSPITAL CHARACTERISTICS

	General	Pneumonia	Stroke	Hernia	Hip
Urban	1.7	.9	4.3	.2	1.3
Rural	3.7	2.3	7.3	.4	1.6
No Teaching	2.6	1.6	5.9	.3	1.3
Minor Teaching	1.4	.6	3.5	.1	1.4
Major Teaching	1.8	1.1	4.8	.4	1.6
Non-COTH	2.3	1.4	5.3	.2	1.4
COTH	1.1	.6	3.3	.2	1.3
Non-Profit	1.9	1.1	4.5	.2	1.3
Profit	2.1	1.4	5.9	.2	1.7
Public	3.2	2.1	6.8	.4	1.5
Size (Beds)					
< 50	5.5	3.3	10.2	.7	2.3
50-99	4.2	2.2	8.4	.6	1.9
100-199	2.4	1.5	6.4	.2	1.6
200-299	1.8	.7	4.1	.1	1.3
300-399	1.5	.7	3.8	.2	1.1
≥ 400	1.2	.6	3.4	.2	1.3
Occupancy Rate					
< 55	3.8	2.2	8.0	.4	1.8
55-69	2.2	1.4	4.9	.3	1.4
70-84	1.8	1.0	4.4	.1	1.3
≥ 85	1.5	.8	3.9	.2	1.4
No ICCU	1.8	1.3	4.8	.2	1.2
ICCU	3.9	2.3	5.7	1.6	2.5

suggest that patients are not being pushed out of the highest quality, most sophisticated hospitals.

As table 6 also shows, patients who have received intensive or coronary care during their initial stay are considerably more likely to be transferred than those who received neither. (Other patient characteristics appear to show no differences.) It is difficult to interpret this finding. Patients who are most seriously ill may be transferred to hospitals more able to tend to them. Alternatively, it is possible that IC/CU use is a good indicator of high cost patients and that the data do suggest dumping of costly patients. The latter theory, however, conflicts with the findings on the characteristics of exporting hospitals.

Table 7 shows the total and various components of length of stay for patients who are and are not transferred. The total length of stay for transferred patients (the sum of the days spent in the initial and transfer hospitals) is clearly longer than that of non-transferred patients suggesting that transferred patients are in a different severity category than others. Except for hernia cases, where the total number of transfer cases is small and the results may therefore be unreliable, length of stay in the initial hospital is slightly shorter or about the same for transfer patients as for non-transfer patients. This implies that patients are not being transferred shortly following admission to the initial hospital. Rather they have a normal length of stay in the initial hospital before moving on to

Table 7

Total Length of Stay for Transferred and Non-Transferred Patients

	LOS in Initial Hospital		LOS in Transfer Hospital		Total LOS	
	No Transfer	Transfer	No Transfer	Transfer	No Transfer	Transfer
General-Median	6	5	0	10	6	17
Mean	9.0	7.9	0	14.0	9.0	21.9
Pneumonia-Median	8	7	0	11	8	20
Mean	10.4	9.5	0	14.5	10.4	24.1
Stroke-Median	9	9	0	18	9	29
Mean	13.0	11.9	0	22.5	13.0	34.4
Hernia-Median	4	8	0	10.5	4	20
Mean	5.6	10.9	0	15.1	5.6	25.9
Hip-Median	14	13	0	14	14	26
Mean	16.7	16.1	0	17.1	16.7	33.2

another hospital for further care.

7. Conclusion

This paper has attempted to measure changes in readmission and transfer rates that might reasonably be attributable to PPS by accounting for many of the other factors that can be expected to influence these rates. While there is considerable variation across different tracer categories, in analysis of beneficiary level data, a dummy variable measuring the onset of PPS suggests that the rate of readmission has increased for all. The surgical tracers, hip replacement and hernia repair, have experienced the largest growth. Hospital characteristics do not play a strong role in explaining differences in the probability of readmission, but patient characteristics are important. One unmeasured attribute, changing case mix, may explain some of the trend associated with PPS, although some of that effect appears to be measured by length of stay. Length of stay is positively related to the probability of readmission, probably because both are affected by a patient's severity, although it is impossible to rule out the hypothesis that longer hospital stays themselves increase the likelihood of readmission. There is no evidence, however, to suggest that the shortened lengths of stay found today are leading to more readmissions in aggregate. Analysis of time series of hospital level data also shows an increase in the rate of readmission between 1981 and 1986, but attributes most of the growth to a simple linear time trend. Work at the hospital level is more preliminary than at the beneficiary level, however.

A subset of readmissions that can reasonably be attributed to complications resulting from the initial stay was also examined for hip replacement and hernia repair cases. These readmissions have also shown a significant increase since the beginning of PPS. They appear to be less affected by patient characteristics, which is not surprising if they are true complications from inappropriate care.

Finally, rates of transfer to other hospitals were examined over time and by hospital characteristics. There appears to be no increase over time for any of the tracers. The hospital characteristics associated with exporting hospitals: small size, rural location, and a low occupancy do not suggest that costly patients are being dumped to lower quality hospitals, but without information on the importing hospitals, it is impossible to draw firm conclusions.

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APPENDIX

REGRESSION OUTPUT

Disease Category	Page
Hip Replacement	A1
Hernia Repair	A7
Stroke	A13
Pneumonia	A19
General	A25
Hip Replacement-Complication Diagnoses	A31
Hernia Repair-Complication Diagnoses	A37

Hips - 14 Day
PPS Dummy

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                                    FILE                                                                    9:55 THURSDAY, SEPTEMBER 1, 1988    1

                   SUM OF          MEAN
SOURCE     DF     SQUARES        SQUARE       F VALUE       PROB>F

MODEL      28   16.641044      0.594323         8.566       0.0001
ERROR   27311    1894.935      0.069384
C TOTAL27339     1911.576

    ROOT MSE     0.263408      R-SQUARE        0.0087
    DEP MEAN     0.075640      ADJ R-SQ        0.0077
    C.V.         348.2382

                PARAMETER      STANDARD    T FOR HO:                       VARIABLE
VARIABLE  DF     ESTIMATE         ERROR  PARAMETER=0    PROB > !T!           LABEL

INTERCEP   1     0.077588      0.040034        1.938       0.0526  INTERCEPT
AGE        1  0.001524051  0.0002110901        7.220       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1    -0.043186    0.00856633       -5.041       0.0001
BED_DUM1   1  -0.00077433      0.014446       -0.054       0.9573
BED_DUM2   1     0.013506   0.008031061        1.682       0.0926
BED_DUM3   1  0.004920019   0.005552968        0.886       0.3756
BED_DUM4   1  0.004589765   0.004929332        0.931       0.3518
BED_DUM5   1  0.006609273   0.004909643        1.346       0.1783
CAPINC     1  -0.00140402  0.0009382385       -1.496       0.1346  MEAN PER CAPITA INCOME (TEBI)
EDUC       1  -0.00260945   0.003045049       -0.857       0.3915  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1    -0.010964   0.003646922       -3.006       0.0026
GOV_DUM    1  -0.00311794   0.005054663       -0.617       0.5373
HMOPOP     1 .00002561134   0.000217969        0.117       0.9065  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1    -0.025858      0.016185       -1.598       0.1101
HOS_RUR    1  -0.00152739   0.005119075       -0.298       0.7654
ICCU_YN    1     0.031458   0.004644029        6.774       0.0001
LOS        1 .00003292987  0.0002131537        0.154       0.8772  LENGTH OF STAY
LOSSQRD    1 -4.33642E-07   9.95421E-07       -0.436       0.6631
NHBPOP     1 -.0000049102  .00000402549       -1.220       0.2226  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1   0.00206889   0.008009317        0.258       0.7962
PHYSPOP    1 .00000757598  .00001852037        0.409       0.6825  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1  0.004416568   0.005415426        0.816       0.4148
SPMDPCT    1 -0.000345193  .00009083332       -3.800       0.0001  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1  0.005678512     0.0039248        1.447       0.1480
TCH2_DUM   1     0.010806   0.004016126        2.691       0.0071
TCH3_DUM   1  0.007432753   0.007398064        1.005       0.3151
TEFRA      1 -.0000968433   0.004622857       -0.021       0.9833
PPS_DUM    1     0.012783   0.004870176        2.625       0.0087
IPRDAY60   1  0.002292238  0.0003884692        5.901       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                                    9:55 THURSDAY, SEPTEMBER 1, 1988    2
Hips - 30 Day
  PPS Dummy

                        SUM OF         MEAN
SOURCE      DF         SQUARES       SQUARE       F VALUE      PROB>F

MODEL       28       35.124206     1.254436        12.835      0.0001
ERROR    27311        2669.183     0.097733
C TOTAL27339          2704.308

    ROOT MSE          0.312623     R-SQUARE        0.0130
    DEP MEAN          0.111302     ADJ R-SQ        0.0120
    C.V.              280.8775

                     PARAMETER     STANDARD    T FOR H0:                      VARIABLE
VARIABLE    DF        ESTIMATE        ERROR  PARAMETER=0   PROB > !T!           LABEL

INTERCEP     1        0.111955     0.047514         2.356       0.0185  INTERCEPT
AGE          1  0.002296371 0.0002505301           9.166       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1       -0.057487     0.010167        -5.654       0.0001
BED_DUM1     1    -0.00135872      0.017145        -0.079       0.9368
BED_DUM2     1        0.015163  0.009531582         1.591       0.1117
BED_DUM3     1 0.0001882283  0.006590482          0.029       0.9772
BED_DUM4     1 -.0000549525  0.005850326         -0.009       0.9925
BED_DUM5     1  0.005623551  0.005826959          0.965       0.3345
CAPINC       1     -0.0024421  0.001113539         -2.193       0.0283  MEAN PER CAPITA INCOME (TEBI)
EDUC         1    -0.00540061  0.003613985         -1.494       0.1351  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1       -0.017209  0.004328312        -3.976       0.0001
GOV_DUM      1  0.002064641  0.005999074          0.344       0.7307
HMOPOP       1 .00008386353 0.0002586942          0.324       0.7458  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1       -0.040934     0.019208        -2.131       0.0331
HOS_RUR      1 -0.000457529   0.00607552         -0.075       0.9400
ICCU_YN      1        0.038934  0.005511718         7.064       0.0001
LOS          1  0.001015526 0.0002529792          4.014       0.0001  LENGTH OF STAY
LOSSQRD      1 -.0000035361 0.0000011814         -2.993       0.0028
NHBPOP       1 -.0000092165 .00000477761         -1.929       0.0537  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1     0.00532186  0.009505775          0.560       0.5756
PHYSPOP      1 .00000257143 .00002198071          0.117       0.9069  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1  0.006525199  0.006427241          1.015       0.3100
SPMDPCT      1 -0.000317035 0.0001078046         -2.941       0.0033  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1  0.007836784  0.004658108          1.682       0.0925
TCH2_DUM     1  0.003922942  0.004766497          0.823       0.4105
TCH3_DUM     1 -0.000443378  0.008780316         -0.050       0.9597
TEFRA        1 0.0002640584  0.005486589          0.048       0.9616
PPS_DUM      1        0.016373  0.005780118         2.833       0.0046
IPRDAY60     1  0.003653568 0.0004610506          7.924       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hips - 60 Day
PPS Dummy

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                                                                      9:55 THURSDAY, SEPTEMBER 1, 1988    3

                    SUM OF        MEAN
SOURCE    DF       SQUARES      SQUARE       F VALUE      PROB>F

MODEL      28    72.284387    2.581585        19.660      0.0001
ERROR   27311     3586.280    0.131313
C TOTAL27339      3658.564

    ROOT MSE      0.362371    R-SQUARE        0.0198
    DEP MEAN      0.159144    ADJ R-SQ        0.0188
    C.V.          227.6998

                 PARAMETER     STANDARD   T FOR H0:                     VARIABLE
VARIABLE  DF      ESTIMATE        ERROR PARAMETER=0  PROB > !T!          LABEL

INTERCEP   1      0.131293     0.055076       2.384      0.0171  INTERCEPT
AGE        1  0.002904354 0.0002903974      10.001      0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1     -0.080470     0.011785      -6.828      0.0001
BED_DUM1   1  0.005897878     0.019874       0.297      0.7666
BED_DUM2   1      0.017617     0.011048       1.595      0.1108
BED_DUM3   1  0.005814274  0.007639238       0.761      0.4466
BED_DUM4   1  0.008281563    0.0067813       1.221      0.2220
BED_DUM5   1  0.006253654  0.006754214       0.926      0.3545
CAPINC     1  -0.00288944  0.001290738      -2.239      0.0252  MEAN PER CAPITA INCOME (TEBI)
EDUC       1  -0.00524666  0.004189085      -1.252      0.2104  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1    -0.031147  0.005017084      -6.208      0.0001
GOV_DUM    1  0.005101635  0.006953719       0.734      0.4632
HMOPOP     1 -.0000670637 0.0002998607      -0.224      0.8230  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1    -0.038575     0.022265      -1.733      0.0832
HOS_RUR    1    0.0016649  0.007042329       0.236      0.8131
ICCU_YN    1     0.047753  0.006388808       7.474      0.0001
LOS        1  0.002062026 0.0002932363       7.032      0.0001  LENGTH OF STAY
LOSSQRD    1 -.0000062353 0.0000013694      -4.553      0.0001
NHBPOP     1 -.0000167509 .00000553788      -3.025      0.0025  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1     0.015452     0.011018       1.402      0.1608
PHYSPOP    1 .00001189023 .00002547855       0.467      0.6407  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1  0.007091198  0.007450021       0.952      0.3412
SPMDPCT    1 -0.000416165 0.0001249597      -3.330      0.0009  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1     0.014929  0.005399361       2.765      0.0057
TCH2_DUM   1  0.000340123  0.005524999       0.062      0.9509
TCH3_DUM   1  -0.00665387     0.010178      -0.654      0.5133
TEFRA      1  0.001418341  0.006359681       0.223      0.8235
PPS_DUM    1     0.020945  0.006699919       3.126      0.0018
IPRDAY60   1  0.005894399 0.0005344185      11.030      0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hips - 14 Day
PPS Trend

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                                                                                       9:55 THURSDAY, SEPTEMBER 1, 1988    5

                      SUM OF          MEAN
SOURCE     DF        SQUARES        SQUARE       F VALUE        PROB>F

MODEL      28      16.697457      0.596338         8.595        0.0001
ERROR   27311       1894.879      0.069382
C TOTAL27339        1911.576

    ROOT MSE        0.263404      R-SQUARE        0.0087
    DEP MEAN        0.075640      ADJ R-SQ        0.0077
    C.V.             348.233

                   PARAMETER      STANDARD    T FOR H0:                    VARIABLE
VARIABLE  DF        ESTIMATE         ERROR  PARAMETER=0    PROB > !T!        LABEL

INTERCEP   1        0.082702      0.039747        2.081        0.0375  INTERCEPT
AGE        1      0.00152534  0.0002110777        7.226        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1       -0.043206   0.008566175       -5.044        0.0001
BED_DUM1   1     -0.00089261      0.014442       -0.062        0.9507
BED_DUM2   1        0.013202   0.008022703        1.646        0.0999
BED_DUM3   1     0.004731661   0.005548558        0.853        0.3938
BED_DUM4   1      0.00463885   0.004929471        0.941        0.3467
BED_DUM5   1     0.006613766   0.004909464        1.347        0.1779
CAPINC     1     -0.00127841  0.0009166809       -1.395        0.1631  MEAN PER CAPITA INCOME (TEBI)
EDUC       1     -0.00268466   0.003042067       -0.883        0.3775  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1       -0.010899    0.00364695       -2.989        0.0028
GOV_DUM    1     -0.00315296    0.00505434       -0.624        0.5328
HMOPOP     1    0.0000089995  0.0002176679        0.041        0.9670  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1       -0.029473      0.015814       -1.864        0.0624
HOS_RUR    1     -0.00160275   0.005119643       -0.313        0.7542
ICCU_YN    1        0.031589   0.004644372        6.802        0.0001
LOS        1    .00001795854  0.0002121598        0.085        0.9325  LENGTH OF STAY
LOSSQRD    1    -3.71023E-07    9.92927E-07       -0.374        0.7087
NHBPOP     1    -.0000050686  .00000402654       -1.259        0.2081  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1     0.002503459   0.008002423        0.313        0.7544
PHYSPOP    1    .00000695852  .00001849409        0.376        0.7067  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1     0.003702714    0.00542298        0.683        0.4948
SPMDPCT    1    -0.000346393  .00009080303       -3.815        0.0001  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1     0.006437216   0.003849625        1.672        0.0945
TCH2_DUM   1        0.010712   0.004016784        2.667        0.0077
TCH3_DUM   1     0.007874149   0.007394808        1.065        0.2870
TEFRA      1     -0.00243614   0.004126373       -0.590        0.5549
TREND1     1     0.005803518    0.00209115        2.775        0.0055
IPRDAY60   1     0.002294122   0.000388464        5.906        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                                9:55 THURSDAY, SEPTEMBER 1, 1988    6
Hips - 30 Day
   PPS Trend


                         SUM OF         MEAN
SOURCE      DF          SQUARES       SQUARE       F VALUE        PROB>F

MODEL       28        35.358348     1.262798        12.922        0.0001
ERROR    27311         2668.949     0.097724
C TOTAL27339           2704.308

    ROOT MSE           0.312609     R-SQUARE        0.0131
    DEP MEAN           0.111302     ADJ R-SQ        0.0121
    C.V.               280.8652


                      PARAMETER     STANDARD    T FOR H0:                      VARIABLE
VARIABLE    DF         ESTIMATE        ERROR  PARAMETER=0   PROB > !T!          LABEL

INTERCEP     1         0.117361     0.047172        2.488       0.0129  INTERCEPT
AGE          1      0.002297273 0.0002505081        9.170       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1        -0.057506     0.010166       -5.656       0.0001
BED_DUM1     1      -0.00131596     0.017139       -0.077       0.9388
BED_DUM2     1         0.014886  0.009521385        1.563       0.1180
BED_DUM3     1     .00001283491  0.006585057        0.002       0.9984
BED_DUM4     1     .00003047639  0.005850322        0.005       0.9958
BED_DUM5     1      0.005659865  0.005826577        0.971       0.3314
CAPINC       1      -0.00235872  0.001087922       -2.168       0.0302  MEAN PER CAPITA INCOME (TEBI)
EDUC         1      -0.00544114   0.00361034       -1.507       0.1318  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1        -0.017120   0.00432822       -3.955       0.0001
GOV_DUM      1      0.002037754  0.005998516        0.340       0.7341
HMOPOP       1     .00006433924 0.0002583294        0.249       0.8033  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1        -0.044724     0.018768       -2.383       0.0172
HOS_RUR      1     -0.000640808  0.006076019       -0.105       0.9160
ICCU_YN      1         0.039120  0.005511965        7.097       0.0001
LOS          1      0.001003463 0.0002517924        3.985       0.0001  LENGTH OF STAY
LOSSQRD      1     -.0000034763 .00000117841       -2.950       0.0032
NHBPOP       1     -.0000094497 .00000477872       -1.977       0.0480  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1      0.005818867  0.009497317        0.613       0.5401
PHYSPOP      1     .00000216043 .00002194889        0.098       0.9216  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1      0.005530787   0.00643602        0.859       0.3902
SPMDPCT      1     -0.000317571 0.0001077655       -2.947       0.0032  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1      0.008609983  0.004568755        1.885       0.0595
TCH2_DUM     1      0.003771301  0.004767141        0.791       0.4289
TCH3_DUM     1       0.00010805  0.008776197        0.012       0.9902
TEFRA        1      -0.00226218  0.004897201       -0.462       0.6441
TREND1       1      0.008011443  0.002481788        3.228       0.0012
IPRDAY60     1      0.003656167 0.0004610311        7.930       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hips - 60 Day
PPS Trend

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                      SUM OF          MEAN
SOURCE     DF        SQUARES        SQUARE       F VALUE       PROB>F

MODEL      28      73.278519      2.617090        19.936       0.0001
ERROR   27311       3585.285      0.131276
C TOTAL27339        3658.564

    ROOT MSE        0.362321      R-SQUARE        0.0200
    DEP MEAN        0.159144      ADJ R-SQ        0.0190
    C.V.            227.6683

                   PARAMETER      STANDARD    T FOR H0:                     VARIABLE
VARIABLE  DF        ESTIMATE         ERROR  PARAMETER=0   PROB > !T!          LABEL

INTERCEP   1        0.134776      0.054673        2.465       0.0137  INTERCEPT
AGE        1  0.002903261 0.0002903444          9.999       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1       -0.080475      0.011783       -6.830       0.0001
BED_DUM1   1  0.006535039      0.019865          0.329       0.7422
BED_DUM2   1        0.017599      0.011035        1.595       0.1108
BED_DUM3   1  0.005787406  0.007632226          0.758       0.4483
BED_DUM4   1  0.008458473  0.006780652          1.247       0.2122
BED_DUM5   1  0.006391733  0.006753131          0.946       0.3439
CAPINC     1  -0.00301513  0.001260925         -2.391       0.0168  MEAN PER CAPITA INCOME (TEBI)
EDUC       1  -0.00513117  0.004184464         -1.226       0.2201  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1       -0.031013  0.005016502       -6.182       0.0001
GOV_DUM    1  0.005121098  0.006952413          0.737       0.4614
HMOPOP     1 -.0000867819 0.0002994094         -0.290       0.7719  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1       -0.040903      0.021752       -1.880       0.0601
HOS_RUR    1  0.001170306   0.00704224          0.166       0.8680
ICCU_YN    1        0.048044  0.006388489         7.520       0.0001
LOS        1  0.002067923 0.0002918329          7.086       0.0001  LENGTH OF STAY
LOSSQRD    1 -.0000062198 0.0000013658         -4.554       0.0001
NHBPOP     1 -.0000171402  .00000553864        -3.095       0.0020  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1        0.015909      0.011008        1.445       0.1484
PHYSPOP    1  .00001250348 .00002543925         0.492       0.6231  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1  0.005579128   0.00745949          0.748       0.4545
SPMDPCT    1 -0.000413851 0.0001249026         -3.313       0.0009  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1        0.015322  0.005295288         2.894       0.0038
TCH2_DUM   1 0.0000524615  0.005525221          0.009       0.9924
TCH3_DUM   1   -0.0059903      0.010172         -0.589       0.5559
TEFRA      1 -0.000403708  0.005675964         -0.071       0.9433
TREND1     1        0.011981  0.002876447         4.165       0.0001
IPRDAY60   1  0.005898281 0.0005343452         11.038       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                              9:52 THURSDAY, SEPTEMBER 1, 1988    1
     Hernia - 14 Day
       PPS Dummy


                      SUM OF         MEAN
SOURCE      DF       SQUARES       SQUARE       F VALUE       PROB>F

MODEL       28     20.626794     0.736671        21.747       0.0001
ERROR    27824       942.542     0.033875
C TOTAL27852         963.169

    ROOT MSE        0.184052     R-SQUARE        0.0214
    DEP MEAN        0.035867     ADJ R-SQ        0.0204
    C.V.            513.1533


                   PARAMETER     STANDARD   T FOR H0:                       VARIABLE
VARIABLE    DF      ESTIMATE        ERROR  PARAMETER=0   PROB > !T!            LABEL

INTERCEP     1   0.002198587     0.029298        0.075       0.9402  INTERCEPT
AGE          1   0.000744629 0.0001682719        4.425       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.010323  0.005576498       -1.851       0.0642
BED_DUM1     1   0.006017447  0.006753158        0.891       0.3729
BED_DUM2     1    0.00236949  0.005062174        0.468       0.6397
BED_DUM3     1  0.0006884533  0.003950222        0.174       0.8616
BED_DUM4     1  -.0000720502  0.003541499       -0.020       0.9838
BED_DUM5     1   0.003107209  0.003601978        0.863       0.3883
CAPINC       1  0.0001319075 0.0002629897        0.502       0.6160  MEAN PER CAPITA INCOME (TEBI)
EDUC         1   -0.00123862   0.00221505       -0.559       0.5760  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1     -0.011419  0.003516238       -3.248       0.0012
GOV_DUM      1  0.0001162269  0.003395163        0.034       0.9727
HMOPOP       1  0.0002919002 0.0001609523        1.814       0.0698  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1     -0.023902     0.010413       -2.295       0.0217
HOS_RUR      1   0.002684493  0.003496426        0.768       0.4426
ICCU_YN      1      0.033739  0.005722363        5.896       0.0001
LOS          1   0.004492265 0.0003248482       13.829       0.0001  LENGTH OF STAY
LOSSQRD      1  -.0000313639 .00000395422       -7.932       0.0001
NHBPOP       1  -.0000029164 .00000286294       -1.019       0.3084  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1  0.0009551538  0.004825835        0.198       0.8431
PHYSPOP      1  -0.000006796 .00001269545       -0.535       0.5924  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   -0.00263802  0.003684652       -0.716       0.4740
SPMDPCT      1  -0.000183223 .00006590053       -2.780       0.0054  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.009100268   0.00265841        3.423       0.0006
TCH2_DUM     1  0.0007214542  0.002929718        0.246       0.8055
TCH3_DUM     1   0.005196312  0.005504448        0.944       0.3452
TEFRA        1   0.001879757  0.002955116        0.636       0.5247
PPS_DUM      1      0.011276  0.003082517        3.658       0.0003
IPRDAY60     1   0.003007117 0.0004156159        7.235       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hernia - 30 Day
PPS Dummy

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                                                                              9:52 THURSDAY, SEPTEMBER 1, 1988    2

                    SUM OF          MEAN
SOURCE     DF      SQUARES        SQUARE       F VALUE       PROB>F

MODEL      28    45.260098      1.616432        30.216       0.0001
ERROR   27824     1488.467      0.053496
C TOTAL27852      1533.727

    ROOT MSE      0.231292      R-SQUARE        0.0295
    DEP MEAN      0.058486      ADJ R-SQ        0.0285
    C.V.          395.4674

                 PARAMETER      STANDARD    T FOR H0:                     VARIABLE
VARIABLE  DF      ESTIMATE         ERROR  PARAMETER=0   PROB > !T!         LABEL

INTERCEP   1      0.023941      0.036817        0.650       0.5155  INTERCEPT
AGE        1   0.001061705  0.0002114613        5.021       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1     -0.018683   0.007007784       -2.666       0.0077
BED_DUM1   1   0.005416072   0.008486451        0.638       0.5233
BED_DUM2   1   0.004915038   0.006361452        0.773       0.4397
BED_DUM3   1   0.001489577   0.004964102        0.300       0.7641
BED_DUM4   1   0.003404228   0.004450474        0.765       0.4443
BED_DUM5   1   0.001501252   0.004526476        0.332       0.7401
CAPINC     1  0.0009990095  0.0003304897        3.023       0.0025  MEAN PER CAPITA INCOME (TEBI)
EDUC       1   -0.00371214   0.002783574       -1.334       0.1824  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1     -0.015710    0.00441873       -3.555       0.0004
GOV_DUM    1   0.001845608   0.004266579        0.433       0.6653
HMOPOP     1  0.0004198566  0.0002022629        2.076       0.0379  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1     -0.027187      0.013086       -2.078       0.0378
HOS_RUR    1   0.005686644   0.004393833        1.294       0.1956
ICCU_YN    1      0.029312   0.007191088        4.076       0.0001
LOS        1   0.006971531   0.000408225       17.078       0.0001  LENGTH OF STAY
LOSSQRD    1  -.0000460195   .00000496913       -9.261       0.0001
NHBPOP     1  -.0000055597   .00000359775      -1.545       0.1223  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1   -0.00131084   0.006064453       -0.216       0.8289
PHYSPOP    1  -.0000044611   .00001595391      -0.280       0.7798  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1   -0.00320873   0.004630369       -0.693       0.4883
SPMDPCT    1  -0.000245308   .00008281482      -2.962       0.0031  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1      0.013817   0.003340728        4.136       0.0001
TCH2_DUM   1   -0.00367132   0.003681672       -0.997       0.3187
TCH3_DUM   1  -0.000667083   0.006917242       -0.096       0.9232
TEFRA      1  -0.000880476   0.003713588       -0.237       0.8126
PPS_DUM    1      0.010991   0.003873688        2.837       0.0046
IPRDAY60   1   0.005549795  0.0005222895       10.626       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                    9:52 THURSDAY, SEPTEMBER 1, 1988    3
  Hernia - 60 Day
    PPS Dummy

                        SUM OF           MEAN
SOURCE     DF          SQUARES         SQUARE        F VALUE        PROB>F

MODEL      28        86.559990       3.091428         37.921        0.0001
ERROR   27824         2268.297       0.081523
C TOTAL27852          2354.857

    ROOT MSE          0.285522       R-SQUARE         0.0368
    DEP MEAN          0.093240       ADJ R-SQ         0.0358
    C.V.              306.2247


                     PARAMETER       STANDARD    T FOR H0:                         VARIABLE
VARIABLE   DF         ESTIMATE          ERROR  PARAMETER=0     PROB > !T!           LABEL

INTERCEP    1         0.016952       0.045450        0.373         0.7092  INTERCEPT
AGE         1      0.001575138 0.0002610425        6.034         0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1        -0.048112    0.008650897       -5.561         0.0001
BED_DUM1    1         0.023640       0.010476        2.257         0.0240
BED_DUM2    1      0.007551767    0.007853019        0.962         0.3362
BED_DUM3    1      0.001884332    0.006128033        0.307         0.7585
BED_DUM4    1      0.009614735    0.005493975        1.750         0.0801
BED_DUM5    1      0.004915896    0.005587797        0.880         0.3790
CAPINC      1      0.001862626 0.0004079794        4.565         0.0001  MEAN PER CAPITA INCOME (TEBI)
EDUC        1      -0.00322564    0.003436237       -0.939         0.3479  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1        -0.022390    0.005454788       -4.105         0.0001
GOV_DUM     1      0.001777734    0.005266961        0.338         0.7357
HMOPOP      1     0.0004823986 0.0002496874        1.932         0.0534  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1        -0.023630       0.016154       -1.463         0.1435
HOS_RUR     1      0.003151689    0.005424053        0.581         0.5612
ICCU_YN     1         0.037872    0.008877179        4.266         0.0001
LOS         1      0.009540642 0.0005039413       18.932         0.0001  LENGTH OF STAY
LOSSQRD     1     -.0000588425   .00000613424       -9.592         0.0001
NHBPOP      1     -.0000039249   .00000444132       -0.884         0.3769  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1      0.002772501    0.007486383        0.370         0.7111
PHYSPOP     1     -0.000013744   .00001969462       -0.698         0.4853  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1      -0.00321773     0.00571605       -0.563         0.5735
SPMDPCT     1     -0.000320176 0.0001022324       -3.132         0.0017  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1         0.010305    0.004124027        2.499         0.0125
TCH2_DUM    1      -0.00188353    0.004544911       -0.414         0.6786
TCH3_DUM    1      -0.00360509    0.008539125       -0.422         0.6729
TEFRA       1     0.0005371925    0.004584312        0.117         0.9067
PPS_DUM     1         0.018775     0.00478195        3.926         0.0001
IPRDAY60    1      0.008322472 0.0006447505       12.908         0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hernia - 14 Day
PPS Trend

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                       SUM OF         MEAN
SOURCE     DF         SQUARES       SQUARE       F VALUE        PROB>F

MODEL      28       20.383531     0.727983        21.485        0.0001
ERROR   27824         942.785     0.033884
C TOTAL27852          963.169

    ROOT MSE         0.184076     R-SQUARE        0.0212
    DEP MEAN         0.035867     ADJ R-SQ        0.0202
    C.V.             513.2195

                    PARAMETER     STANDARD    T FOR H0:                   VARIABLE
VARIABLE   DF        ESTIMATE        ERROR  PARAMETER=0   PROB > !T!        LABEL

INTERCEP    1   0.00930494      0.029182        0.319        0.7498  INTERCEPT
AGE         1 0.0007606541 0.0001681999         4.522        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1    -0.010651  0.005575895        -1.910        0.0561
BED_DUM1    1  0.005211563  0.006749058         0.772        0.4400
BED_DUM2    1  0.001755355  0.005058244         0.347        0.7286
BED_DUM3    1 0.0004977397  0.003951712         0.126        0.8998
BED_DUM4    1 -.0000174296  0.003542815        -0.005        0.9961
BED_DUM5    1  0.003091866  0.003602776         0.858        0.3908
CAPINC      1 0.0001838273 0.0002625391         0.700        0.4838  MEAN PER CAPITA INCOME (TEBI)
EDUC        1  -0.00133364  0.002215121        -0.602        0.5471  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1    -0.011451  0.003516692        -3.256        0.0011
GOV_DUM     1 -.0000226861  0.003395265        -0.007        0.9947
HMOPOP      1 0.0002945903 0.0001609891         1.830        0.0673  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1    -0.029216     0.010232        -2.855        0.0043
HOS_RUR     1  0.002616595  0.003497902         0.748        0.4544
ICCU_YN     1     0.034127  0.005721582         5.965        0.0001
LOS         1  0.004403577 0.0003233965        13.617        0.0001  LENGTH OF STAY
LOSSQRD     1 -.0000306962 .00000394809        -7.775        0.0001
NHBPOP      1 -.0000028985 .00000286366        -1.012        0.3115  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1  0.001285536  0.004825128         0.266        0.7899
PHYSPOP     1 -0.000006572 .00001269795        -0.518        0.6048  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1  -0.00293096  0.003687351        -0.795        0.4267
SPMDPCT     1 -0.000183092 .00006592209        -2.777        0.0055  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1     0.010295  0.002621253         3.928        0.0001
TCH2_DUM    1 0.0008481456  0.002929718         0.289        0.7722
TCH3_DUM    1  0.005585358  0.005503507         1.015        0.3102
TEFRA       1  -0.00126479   0.00271257        -0.466        0.6410
TREND1      1   0.00362812  0.001457195         2.490        0.0128
IPRDAY60    1  0.003011959 0.0004156669         7.246        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hernia - 30 Day                                                      9:52 THURSDAY, SEPTEMBER 1, 1988    6
   PPS Trend


                        SUM OF         MEAN
SOURCE     DF          SQUARES       SQUARE        F VALUE       PROB>F

MODEL      28        45.092453     1.610445         30.101       0.0001
ERROR   27824         1488.634     0.053502
C TOTAL27852          1533.727

    ROOT MSE          0.231305     R-SQUARE         0.0294
    DEP MEAN          0.058486     ADJ R-SQ         0.0284
    C.V.              395.4897


                     PARAMETER     STANDARD    T FOR H0:                   VARIABLE
VARIABLE   DF         ESTIMATE        ERROR  PARAMETER=0    PROB > !T!       LABEL

INTERCEP    1         0.029880     0.036669        0.815        0.4152  INTERCEPT
AGE         1  0.001074319 0.0002113554            5.083        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1    -0.018954  0.007006517           -2.705        0.0068
BED_DUM1    1  0.004805923  0.008480682            0.567        0.5709
BED_DUM2    1  0.004431421  0.006356051            0.697        0.4857
BED_DUM3    1  0.001382973  0.004965613            0.279        0.7806
BED_DUM4    1  0.003490208  0.004451804            0.784        0.4330
BED_DUM5    1  0.001512427   0.00452715            0.334        0.7383
CAPINC      1  0.001037754 0.0003298995            3.146        0.0017  MEAN PER CAPITA INCOME (TEBI)
EDUC        1  -0.00378436   0.00278346           -1.360        0.1740  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1    -0.015744  0.004418979           -3.563        0.0004
GOV_DUM     1  0.001717631  0.004266397            0.403        0.6872
HMOPOP      1 0.0004209221 0.0002022946            2.081        0.0375  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1    -0.031506     0.012857           -2.450        0.0143
HOS_RUR     1  0.005585583  0.004395367            1.271        0.2038
ICCU_YN     1     0.029612  0.007189584            4.119        0.0001
LOS         1  0.006901673 0.0004063712           16.984        0.0001  LENGTH OF STAY
LOSSQRD     1 -.0000455001 .00000496107           -9.171        0.0001
NHBPOP      1 -.0000055668 0.0000035984           -1.547        0.1219  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1  -0.00100612  0.006063124           -0.166        0.8682
PHYSPOP     1 -.0000041873 0.0000159559           -0.262        0.7930  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1  -0.00354035  0.004633425           -0.764        0.4448
SPMDPCT     1  -0.00024584 0.0000828359           -2.968        0.0030  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1     0.014818  0.003293795            4.499        0.0001
TCH2_DUM    1   -0.0035659  0.003681404           -0.969        0.3327
TCH3_DUM    1 -0.000309935  0.006915556           -0.045        0.9643
TEFRA       1  -0.00356317  0.003408541           -1.045        0.2959
TREND1      1   0.00406005  0.001831072            2.217        0.0266
IPRDAY60    1  0.005554432 0.0005223157           10.634        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hernia - 60 Day
PPS Trend

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                                                                                    9:52 THURSDAY, SEPTEMBER 1, 1988     7

                     SUM OF          MEAN
SOURCE     DF       SQUARES        SQUARE       F VALUE       PROB>F

MODEL      28     85.677713      3.059918        37.520       0.0001
ERROR   27824      2269.179      0.081555
C TOTAL27852       2354.857

    ROOT MSE       0.285578      R-SQUARE        0.0364
    DEP MEAN       0.093240      ADJ R-SQ        0.0354
    C.V.           306.2842

                  PARAMETER      STANDARD    T FOR H0:                   VARIABLE
VARIABLE  DF       ESTIMATE         ERROR  PARAMETER=0    PROB > !T!      LABEL

INTERCEP   1       0.031042      0.045273        0.686        0.4929  INTERCEPT
AGE        1     0.00160869  0.0002609478        6.165        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1      -0.048768   0.008650527       -5.638        0.0001
BED_DUM1   1       0.021898      0.010471        2.091        0.0365
BED_DUM2   1     0.00626638   0.007847435        0.799        0.4246
BED_DUM3   1    0.001385552   0.006130745        0.226        0.8212
BED_DUM4   1    0.009630837   0.005496375        1.752        0.0797
BED_DUM5   1     0.00483062   0.005589401        0.864        0.3875
CAPINC     1     0.00197619  0.0004073071        4.852        0.0001  MEAN PER CAPITA INCOME (TEBI)
EDUC       1    -0.00343045   0.003436571       -0.998        0.3182  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1      -0.022439   0.005455849       -4.113        0.0001
GOV_DUM    1    0.001529475   0.005267464        0.290        0.7715
HMOPOP     1   0.0004904358   0.000249761        1.964        0.0496  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1      -0.034446      0.015874       -2.170        0.0300
HOS_RUR    1    0.003118371   0.005426697        0.575        0.5655
ICCU_YN    1       0.038695   0.008876548        4.359        0.0001
LOS        1     0.00935506  0.0005017222       18.646        0.0001  LENGTH OF STAY
LOSSQRD    1   -.0000574304  .00000612513       -9.376        0.0001
NHBPOP     1   -.0000038388  .00000444273       -0.864        0.3876  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1    0.003362147   0.007485775        0.449        0.6533
PHYSPOP    1   -0.000013498  .00001969979       -0.685        0.4932  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1     -0.0036001   0.005720612       -0.629        0.5291
SPMDPCT    1   -0.000318447  0.0001022725       -3.114        0.0018  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1       0.012670   0.004066652        3.116        0.0018
TCH2_DUM   1     -0.0016313   0.004545209       -0.359        0.7197
TCH3_DUM   1    -0.00290689   0.008538223       -0.340        0.7335
TEFRA      1    -0.00557247   0.004208321       -1.324        0.1855
TREND1     1    0.004843796   0.002260714        2.143        0.0322
IPRDAY60   1    0.008330723  0.0006448719       12.918        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 14 Day                                                                  12:24 TUESDAY, SEPTEMBER 6, 1988    1
  PPS Dummy

 DEP VARIABLE: RE_14_YN

                       SUM OF          MEAN
 SOURCE      DF       SQUARES        SQUARE       F VALUE        PROB>F

 MODEL       29     52.778774      1.819958        14.110        0.0001
 ERROR    38336      4944.753      0.128985
 C TOTAL38365        4997.532

     ROOT MSE        0.359144      R-SQUARE        0.0106
     DEP MEAN        0.153964      ADJ R-SQ        0.0098
     C.V.            233.2644

                    PARAMETER      STANDARD     T FOR H0:                    VARIABLE
 VARIABLE    DF      ESTIMATE         ERROR   PARAMETER=0    PROB > !T!        LABEL

 INTERCEP     1      0.333756      0.046235         7.219        0.0001  INTERCEPT
 AGE          1   -0.00219863  0.0002629684        -8.361        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
 AGED         1      0.031184   0.009294921         3.355        0.0008
 BED_DUM1     1      0.059532      0.011287         5.274        0.0001
 BED_DUM2     1      0.040373     0.0085303         4.733        0.0001
 BED_DUM3     1      0.023294   0.006588591         3.536        0.0004
 BED_DUM4     1 0.0003981016   0.005907138         0.067        0.9463
 BED_DUM5     1  0.005779095    0.00593061         0.974        0.3298
 CAPINC       1 -0.000452729  0.0006439456        -0.703        0.4820  MEAN PER CAPITA INCOME (TEBI)
 EDUC         1   -0.0013777   0.003429209        -0.402        0.6879  MEDIAN SCHOOL COMPLETED IN 1970
 FEMALE       1    -0.017087   0.003770768        -4.531        0.0001
 GOV_DUM      1  0.007710134   0.005424088         1.421        0.1552
 HMOPOP       1  0.001298237  0.0002508014         5.176        0.0001  % OF POP ENR IN HMO (SMSA OR COUNTY)
 HOSOCC       1    -0.041673      0.017534        -2.377        0.0175
 HOS_RUR      1     0.011540   0.005882141         1.962        0.0498
 ICCU_YN      1     0.017004   0.004571129         3.720        0.0002
 LOS          1 -.0000303806  0.0001973292        -0.154        0.8776  LENGTH OF STAY
 LOSSQRD      1 -.0000017684  .00000115306        -1.534        0.1251
 NHBPOP       1 -.0000075988  .00000473537        -1.605        0.1086  NURSING HOME BEDS PER 100K POPULATION
 NONWHITE     1   -0.0081853   0.006062442        -1.350        0.1770
 PHYSPOP      1 -.0000037086  .00001803422        -0.206        0.8371  PATIENT CARE DRS. PER 100K POPULATION
 PROF_DUM     1  0.008099785   0.006002664         1.349        0.1772
 SPMDPCT      1  -0.00018099  0.0001028218        -1.760        0.0784  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
 SURG_YN      1     0.011736   0.006337571         1.852        0.0641
 TCH2_DUM     1  0.001305419   0.004850216         0.269        0.7878
 TCH3_DUM     1     0.017301   0.009202443         1.880        0.0601
 SURG_DUM     1    -0.026119   0.005204811        -5.018        0.0001
 TEFRA        1  0.008896805   0.004969898         1.790        0.0734
 PPS_DUM      1     0.024154   0.005129151         4.709        0.0001
 IPRDAY60     1  0.001100215  0.0003038866         3.620        0.0003  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 30 Day
PPS Dummy

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                                                                                    12:24 TUESDAY, SEPTEMBER 6, 1988     2

DEP VARIABLE: RE_30_YN

                   SUM OF          MEAN
SOURCE      DF    SQUARES        SQUARE       F VALUE       PROB>F

MODEL       29  70.663374      2.436668        14.584       0.0001
ERROR    38336   6405.305      0.167083
C TOTAL38365     6475.968

    ROOT MSE     0.408758      R-SQUARE        0.0109
    DEP MEAN     0.215034      ADJ R-SQ        0.0102
    C.V.         190.0899

                PARAMETER      STANDARD    T FOR H0:                      VARIABLE
VARIABLE  DF     ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP   1     0.391615      0.052623        7.442        0.0001  INTERCEPT
AGE        1  -0.00189455  0.0002992962       -6.330        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1     0.024508      0.010579        2.317        0.0205
BED_DUM1   1     0.064780      0.012846        5.043        0.0001
BED_DUM2   1     0.045706   0.009708718        4.708        0.0001
BED_DUM3   1     0.028646   0.007498771        3.820        0.0001
BED_DUM4   1 0.0003648121   0.006723179        0.054        0.9567
BED_DUM5   1  0.007155016   0.006749894        1.060        0.2891
CAPINC     1 -0.000395463  0.0007329034       -0.540        0.5895  MEAN PER CAPITA INCOME (TEBI)
EDUC       1  -0.00163347   0.003902937       -0.419        0.6756  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1    -0.022309   0.004291681       -5.198        0.0001
GOV_DUM    1     0.012882   0.006173399        2.087        0.0369
HMOPOP     1  0.001276199  0.0002854483        4.471        0.0001  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1    -0.053923      0.019956       -2.702        0.0069
HOS_RUR    1     0.011367    0.00669473        1.698        0.0895
ICCU_YN    1     0.024478   0.005202607        4.705        0.0001
LOS        1 0.0001062143  0.0002245892        0.473        0.6363  LENGTH OF STAY
LOSSQRD    1 -.0000029244  .00000131235       -2.228        0.0259
NHBPOP     1 -.0000110326  .00000538954       -2.047        0.0407  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1  -0.00153704   0.006899939       -0.223        0.8237
PHYSPOP    1 -.0000153188  .00002052556       -0.746        0.4555  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1  0.005769723   0.006831902        0.845        0.3984
SPMDPCT    1 -0.000189364  0.0001170262       -1.618        0.1056  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1     0.016154   0.007213074        2.240        0.0251
TCH2_DUM   1 0.0001275397   0.005520249        0.023        0.9816
TCH3_DUM   1     0.018799      0.010474        1.795        0.0727
SURG_DUM   1    -0.027819   0.005923829       -4.696        0.0001
TEFRA      1  0.001647404   0.005656464        0.291        0.7709
PPS_DUM    1     0.019154   0.005837718        3.281        0.0010
IPRDAY60   1  0.002417986  0.0003458671        6.991        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 60 Day
  PPS Dummy                                                                                  12:24 TUESDAY, SEPTEMBER 6, 1988    3

DEP VARIABLE: RE_60_YN

                    SUM OF          MEAN
SOURCE       DF    SQUARES        SQUARE       F VALUE       PROB>F

MODEL        29  79.482369      2.740771        13.472       0.0001
ERROR     38336   7799.375      0.203448
C TOTAL38365      7878.858

    ROOT MSE      0.451052      R-SQUARE        0.0101
    DEP MEAN      0.288719      ADJ R-SQ        0.0093
    C.V.          156.2251

                PARAMETER      STANDARD   T FOR H0:                     VARIABLE
VARIABLE   DF    ESTIMATE         ERROR  PARAMETER=0   PROB > |T|          LABEL

INTERCEP    1     0.494832      0.058067       8.522       0.0001  INTERCEPT
AGE         1  -0.00169162   0.000330264      -5.122       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1     0.010645      0.011674       0.912       0.3618
BED_DUM1    1     0.061404      0.014176       4.332       0.0001
BED_DUM2    1     0.042574      0.010713       3.974       0.0001
BED_DUM3    1     0.027887   0.008274659       3.370       0.0008
BED_DUM4    1     0.011379   0.007418818       1.534       0.1251
BED_DUM5    1  0.006698442   0.007448297       0.899       0.3685
CAPINC      1 -0.000548648   0.000808736      -0.678       0.4975  MEAN PER CAPITA INCOME (TEBI)
EDUC        1  -0.00670565   0.004306768      -1.557       0.1195  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1    -0.023204   0.004735735      -4.900       0.0001
GOV_DUM     1  0.009823043   0.006812152       1.442       0.1493
HMOPOP      1  0.001130982  0.0003149833       3.591       0.0003  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1    -0.034305      0.022021      -1.558       0.1193
HOS_RUR     1     0.026642   0.007387425       3.606       0.0003
ICCU_YN     1     0.029815   0.005740914       5.194       0.0001
LOS         1 0.0002058769  0.0002478272       0.831       0.4061  LENGTH OF STAY
LOSSQRD     1 -.0000043904  .00000144814      -3.032       0.0024
NHBPOP      1 -.0000125583  .00000594719      -2.112       0.0347  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1  0.006693719   0.007613866       0.879       0.3793
PHYSPOP     1 -.0000250276  .00002264931      -1.105       0.2692  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1     0.013398   0.007538789       1.777       0.0755
SPMDPCT     1 -0.000106349  0.0001291347      -0.824       0.4102  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1     0.018611   0.007959401       2.338       0.0194
TCH2_DUM    1  0.004141515   0.006091421       0.680       0.4966
TCH3_DUM    1     0.014567      0.011557       1.260       0.2075
SURG_DUM    1    -0.017326    0.00653676      -2.650       0.0080
TEFRA       1  0.002411197   0.006241731       0.386       0.6993
PPS_DUM     1     0.013440   0.006441739       2.086       0.0370
IPRDAY60    1  0.003545103  0.0003816535       9.289       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 14 Day
PPS Trend

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                                                                                        12:24 TUESDAY, SEPTEMBER 6, 1988    5

DEP VARIABLE: RE_14_YN

                    SUM OF         MEAN
SOURCE     DF      SQUARES       SQUARE      F VALUE       PROB>F

MODEL      29    50.463056     1.740105       13.484       0.0001
ERROR   38336     4947.069     0.129045
C TOTAL38365      4997.532

    ROOT MSE      0.359228     R-SQUARE       0.0101
    DEP MEAN      0.153964     ADJ R-SQ       0.0093
    C.V.           233.319

                 PARAMETER     STANDARD   T FOR H0:                     VARIABLE
VARIABLE  DF      ESTIMATE        ERROR PARAMETER=0    PROB > !T!         LABEL

INTERCEP   1      0.352117     0.046069       7.643        0.0001  INTERCEPT
AGE        1   -0.00216308 0.0002629099      -8.227        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1      0.031229  0.009297092       3.359        0.0008
BED_DUM1   1      0.056895     0.011280       5.044        0.0001
BED_DUM2   1      0.039001  0.008529892       4.572        0.0001
BED_DUM3   1      0.022658  0.006590229       3.438        0.0006
BED_DUM4   1   0.000425676  0.005908568       0.072        0.9426
BED_DUM5   1   0.005689833  0.005931985       0.959        0.3375
CAPINC     1 -.0000425767 0.0006401361      -0.067        0.9470  MEAN PER CAPITA INCOME (TEBI)
EDUC       1   -0.00173284   0.00342919      -0.505        0.6133  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1     -0.016885  0.003771427      -4.477        0.0001
GOV_DUM    1   0.007473018  0.005425105       1.377        0.1684
HMOPOP     1   0.001301542 0.0002509308       5.187        0.0001  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1     -0.058927     0.017166      -3.433        0.0006
HOS_RUR    1      0.012008  0.005886871       2.040        0.0414
ICCU_YN    1      0.016606  0.004572202       3.632        0.0003
LOS        1 -.0000960809 0.0001970094      -0.488        0.6258  LENGTH OF STAY
LOSSQRD    1 -.0000015227 .00000115239      -1.321        0.1864
NHBPOP     1  -0.000007853 .00000473638      -1.658        0.0973  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1   -0.00733765  0.006061454      -1.211        0.2261
PHYSPOP    1 -.0000050376 .00001804048      -0.279        0.7801  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1   0.007467866  0.006006881       1.243        0.2138
SPMDPCT    1  -0.000177338 0.0001028493      -1.724        0.0847  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1      0.015157  0.006301626       2.405        0.0162
TCH2_DUM   1   0.001340114  0.004853245       0.276        0.7825
TCH3_DUM   1      0.017309  0.009204605       1.880        0.0601
SURG_DUM   1     -0.023943  0.005189309      -4.614        0.0001
TEFRA      1   0.001001809  0.004657747       0.215        0.8297
TREND1     1   0.004827823  0.002349818       2.055        0.0399
IPRDAY60   1   0.001059545 0.0003038243       3.487        0.0005  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 30 Day
PPS Trend

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                                                                                         12:24 TUESDAY, SEPTEMBER 6, 1988    6

DEP VARIABLE: RE_30_YN

                       SUM OF          MEAN
SOURCE       DF       SQUARES        SQUARE       F VALUE       PROB>F

MODEL        29     68.869594      2.374814        14.209       0.0001
ERROR     38336      6407.099      0.167130
C TOTAL38365         6475.968

    ROOT MSE         0.408815      R-SQUARE        0.0106
    DEP MEAN         0.215034      ADJ R-SQ        0.0099
      C.V.           190.1165

                    PARAMETER      STANDARD    T FOR H0:                      VARIABLE
VARIABLE     DF      ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP      1      0.411660      0.052428        7.852        0.0001  INTERCEPT
AGE           1   -0.00185623 0.0002992015       -6.204        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED          1      0.024556      0.010580        2.321        0.0203
BED_DUM1      1      0.061616      0.012837        4.800        0.0001
BED_DUM2      1      0.043990    0.00970734        4.532        0.0001
BED_DUM3      1      0.027792   0.007499931        3.706        0.0002
BED_DUM4      1 0.0003523075    0.006724174        0.052        0.9582
BED_DUM5      1    0.00704251   0.006750824        1.043        0.2969
CAPINC        1 0.0001014792 0.0007284992        0.139        0.8892  MEAN PER CAPITA INCOME (TEBI)
EDUC          1   -0.00203292   0.003902548       -0.521        0.6024  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE        1     -0.022077   0.004292026       -5.144        0.0001
GOV_DUM       1      0.012624   0.006173975        2.045        0.0409
HMOPOP        1   0.001288937 0.0002855688        4.514        0.0001  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC        1     -0.073487      0.019535       -3.762        0.0002
HOS_RUR       1      0.012177   0.006699482        1.818        0.0691
ICCU_YN       1      0.023947    0.00520334        4.602        0.0001
LOS           1 .00002769968  0.0002242041        0.124        0.9017  LENGTH OF STAY
LOSSQRD       1 -.0000026341  .00000131146       -2.009        0.0446
NHBPOP        1 -0.000011195  .00000539017       -2.077        0.0378  NURSING HOME BEDS PER 100K POPULATION
NONWHITE      1 -0.000559718   0.006898165       -0.081        0.9353
PHYSPOP       1 -.0000172516  .00002053075       -0.840        0.4008  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM      1   0.005542074   0.006836058        0.811        0.4175
SPMDPCT       1 -0.000183965 0.0001170463       -1.572        0.1160  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN       1      0.020102   0.007171489        2.803        0.0051
TCH2_DUM      1 0.0003771759   0.005523176        0.068        0.9456
TCH3_DUM      1      0.018825      0.010475        1.797        0.0723
SURG_DUM      1     -0.025259    0.00590563       -4.277        0.0001
TEFRA         1   -0.00698616   0.005300693       -1.318        0.1875
TREND1        1 0.0004589684   0.002674182        0.172        0.8637
IPRDAY60      1   0.002373765 0.0003457636        6.865        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Stroke - 60 Day
PPS Trend

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                                                                                   12:24 TUESDAY, SEPTEMBER 6, 1988    7

DEP VARIABLE: RE_60_YN

                    SUM OF        MEAN
SOURCE     DF      SQUARES      SQUARE       F VALUE       PROB>F

MODEL      29    78.604611    2.710504        13.321       0.0001
ERROR   38336     7800.253    0.203471
C TOTAL38365      7878.858

    ROOT MSE      0.451077    R-SQUARE        0.0100
    DEP MEAN      0.288719    ADJ R-SQ        0.0092
    C.V.          156.2339

                 PARAMETER     STANDARD   T FOR H0:                     VARIABLE
VARIABLE  DF      ESTIMATE        ERROR  PARAMETER=0    PROB > !T!       LABEL

INTERCEP   1      0.510363     0.057848        8.823       0.0001  INTERCEPT
AGE        1   -0.00166203 0.0003301318       -5.034       0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1      0.010682     0.011674        0.915       0.3602
BED_DUM1   1      0.058897     0.014164        4.158       0.0001
BED_DUM2   1      0.041202     0.010711        3.847       0.0001
BED_DUM3   1      0.027194  0.008275245        3.286       0.0010
BED_DUM4   1      0.011361  0.007419294        1.531       0.1257
BED_DUM5   1   0.006608339  0.007448699        0.887       0.3750
CAPINC     1   -0.00015403 0.0008038087       -0.192       0.8480  MEAN PER CAPITA INCOME (TEBI)
EDUC       1   -0.00701745  0.004305979       -1.630       0.1032  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1     -0.023022   0.00473572       -4.861       0.0001
GOV_DUM    1    0.00962288  0.006812218        1.413       0.1578
HMOPOP     1   0.001142626 0.0003150898        3.626       0.0003  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1     -0.049605     0.021555       -2.301       0.0214
HOS_RUR    1      0.027328   0.00739205        3.697       0.0002
ICCU_YN    1      0.029386  0.005741241        5.118       0.0001
LOS        1  0.0001437194 0.0002473815        0.581       0.5613  LENGTH OF STAY
LOSSQRD    1  -.0000041612  .00000144703      -2.876       0.0040
NHBPOP     1  -.0000126618  .00000594739      -2.129       0.0333  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1   0.007461102  0.007611271        0.980       0.3270
PHYSPOP    1  -.0000266189  .00002265314      -1.175       0.2400  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1      0.013311  0.007542744        1.765       0.0776
SPMDPCT    1  -0.000101891 0.0001291462       -0.789       0.4301  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1      0.021712  0.007912851        2.744       0.0061
TCH2_DUM   1   0.004376091  0.006094142        0.718       0.4727
TCH3_DUM   1      0.014591     0.011558        1.262       0.2068
SURG_DUM   1     -0.015306  0.006516132       -2.349       0.0188
TEFRA      1    -0.0042815  0.005848659       -0.732       0.4641
TREND1     1  -0.000579174  0.002950629       -0.196       0.8444
IPRDAY60   1   0.003510872 0.0003815073        9.203       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                                   9:58 THURSDAY, SEPTEMBER 1, 1988    1
Pneumonia - 14 Day
   PPS Dummy

                        SUM OF          MEAN
SOURCE      DF         SQUARES        SQUARE       F VALUE       PROB>F

MODEL       29       59.237185      2.042662        21.038       0.0001
ERROR    39759        3860.425      0.097096
C TOTAL39788          3919.662

    ROOT MSE          0.311602      R-SQUARE        0.0151
    DEP MEAN          0.110784      ADJ R-SQ        0.0144
    C.V.              281.2686

                     PARAMETER      STANDARD    T FOR H0:                     VARIABLE
VARIABLE    DF        ESTIMATE         ERROR  PARAMETER=0   PROB > !T!          LABEL

INTERCEP     1        0.206549      0.033714        6.127       0.0001  INTERCEPT
AGE          1  -.0000773371      0.00019025       -0.407       0.6844  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.00417738   0.007326256       -0.570       0.5686
BED_DUM1     1        0.054296   0.008297188        6.544       0.0001
BED_DUM2     1        0.035028   0.006929029        5.055       0.0001
BED_DUM3     1        0.026737   0.005939984        4.501       0.0001
BED_DUM4     1        0.013461    0.00564097        2.386       0.0170
BED_DUM5     1     0.008826552   0.005797831        1.522       0.1279
CAPINC       1     -0.00106263 0.0005605687       -1.896       0.0580  MEAN PER CAPITA INCOME (TEBI)
EDUC         1     -0.00965914   0.002495392       -3.871       0.0001  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1       -0.024647   0.003154995       -7.812       0.0001
GOV_DUM      1     0.007028197   0.004247438        1.655       0.0980
HMOPOP       1  0.0003454301 0.0002339971          1.476       0.1399  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1     -0.00386905      0.013788       -0.281       0.7790
HOS_RUR      1     0.008610515   0.004632272        1.859       0.0631
ICCU_YN      1        0.024745   0.005285808        4.681       0.0001
LOS          1     0.001360526 0.0002851995         4.770       0.0001  LENGTH OF STAY
LOSSQRD      1  -.0000101448  .00000265642         -3.819       0.0001
NHBPOP       1   -0.000002819  .00000360919        -0.781       0.4348  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1       -0.011490   0.005903436       -1.946       0.0516
PHYSPOP      1  -.0000094735  .00001879553         -0.504       0.6142  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1     0.005830743   0.004958271        1.176       0.2396
SPMDPCT      1  -.0000217416  .00008857068         -0.245       0.8061  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1      -0.0016237   0.007741957       -0.210       0.8339
TCH2_DUM     1     0.008236079   0.004563646        1.805       0.0711
TCH3_DUM     1        0.015709    0.00895299        1.755       0.0793
SURG_DUM     1        0.013353   0.005529044        2.415       0.0157
TEFRA        1     0.002738692   0.004206976        0.651       0.5151
PPS_DUM      1      0.00416113   0.004188133        0.994       0.3204
IPRDAY60     1     0.003914241   0.000244124       16.034       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Pneumonia - 30 Day
PPS Dummy

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                                                                                      9:58 THURSDAY, SEPTEMBER 1, 1988    2

                        SUM OF          MEAN
SOURCE      DF         SQUARES        SQUARE         F VALUE        PROB>F

MODEL       29         131.113      4.521154          31.835        0.0001
ERROR    39759        5646.459      0.142017
C TOTAL39788          5777.573

    ROOT MSE          0.376852      R-SQUARE          0.0227
    DEP MEAN          0.176280      ADJ R-SQ          0.0220
    C.V.              213.7803

                     PARAMETER      STANDARD    T FOR H0:                        VARIABLE
VARIABLE   DF         ESTIMATE         ERROR  PARAMETER=0    PROB > !T!           LABEL

INTERCEP    1         0.270123      0.040774        6.625        0.0001  INTERCEPT
AGE         1   .00004582573 0.0002300887        0.199        0.8421  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1        -0.018980   0.008860386       -2.142        0.0322
BED_DUM1    1         0.064795      0.010035        6.457        0.0001
BED_DUM2    1         0.045971   0.008379978        5.486        0.0001
BED_DUM3    1         0.040387   0.007183826        5.622        0.0001
BED_DUM4    1         0.024557   0.006822198        3.600        0.0003
BED_DUM5    1         0.016221   0.007011906        2.313        0.0207
CAPINC      1      -0.00184485  0.0006779527       -2.721        0.0065  MEAN PER CAPITA INCOME (TEBI)
EDUC        1        -0.010619   0.003017931       -3.519        0.0004  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1        -0.036537   0.003815656       -9.576        0.0001
GOV_DUM     1         0.014316   0.005136858        2.787        0.0053
HMOPOP      1    0.0006622812  0.0002829965        2.340        0.0193  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1     -0.000287291      0.016675       -0.017        0.9863
HOS_RUR     1         0.014484   0.005602277        2.585        0.0097
ICCU_YN     1         0.035686   0.006392664        5.582        0.0001
LOS         1      0.002536357  0.0003449207        7.353        0.0001  LENGTH OF STAY
LOSSQRD     1    -.0000177782  .00000321268       -5.534        0.0001
NHBPOP      1    -.0000085642  .00000436495       -1.962        0.0498  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1        -0.017580   0.007139624       -2.462        0.0138
PHYSPOP     1    .00002732534  .00002273134        1.202        0.2293  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1      0.006140203   0.005996541        1.024        0.3059
SPMDPCT     1     -0.000133013  0.0001071175       -1.242        0.2143  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1        -0.012750   0.009363135       -1.362        0.1733
TCH2_DUM    1         0.011802   0.005519281        2.138        0.0325
TCH3_DUM    1         0.010907      0.010828        1.007        0.3138
SURG_DUM    1         0.017566   0.006686834        2.627        0.0086
TEFRA       1      0.005055067   0.005087923        0.994        0.3205
PPS_DUM     1         0.012023   0.005065135        2.374        0.0176
IPRDAY60    1      0.006163624   0.000295244       20.876        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Pneumonia - 60 Day
PPS Dummy

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                      SUM OF          MEAN
SOURCE     DF        SQUARES        SQUARE       F VALUE        PROB>F

MODEL      29        186.748      6.439595        34.721        0.0001
ERROR   39759       7374.031      0.185468
C TOTAL39788        7560.779

     ROOT MSE       0.430660      R-SQUARE        0.0247
     DEP MEAN       0.255096      ADJ R-SQ        0.0240
     C.V.            168.823


                   PARAMETER      STANDARD    T FOR H0:                       VARIABLE
VARIABLE  DF        ESTIMATE         ERROR  PARAMETER=0    PROB > !T!           LABEL

INTERCEP   1        0.365837      0.046596        7.851        0.0001  INTERCEPT
AGE        1 0.0002132168 0.0002629418          0.811        0.4174  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1       -0.030054      0.010126       -2.968        0.0030
BED_DUM1   1        0.062248      0.011467        5.428        0.0001
BED_DUM2   1        0.043448    0.00957651        4.537        0.0001
BED_DUM3   1        0.039440   0.008209565        4.804        0.0001
BED_DUM4   1        0.026615   0.007796303        3.414        0.0006
BED_DUM5   1        0.012624   0.008013098        1.575        0.1152
CAPINC     1   -0.00195881 0.0007747539        -2.528        0.0115  MEAN PER CAPITA INCOME (TEBI)
EDUC       1       -0.013276   0.003448845       -3.849        0.0001  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1       -0.040055   0.004360473       -9.186        0.0001
GOV_DUM    1        0.014378   0.005870322        2.449        0.0143
HMOPOP     1 0.0009179331    0.000323404        2.838        0.0045  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1  0.002923667       0.019056        0.153        0.8781
HOS_RUR    1        0.013097   0.006402196        2.046        0.0408
ICCU_YN    1        0.033364   0.007305438        4.567        0.0001
LOS        1  0.003251985 0.0003941701          8.250        0.0001  LENGTH OF STAY
LOSSQRD    1   -0.00002251 0.0000036714        -6.131        0.0001
NHBPOP     1 -.0000073019 0.0000049882        -1.464        0.1432  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1       -0.026872   0.008159053       -3.294        0.0010
PHYSPOP    1 -.0000071002 .00002597703        -0.273        0.7846  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1  0.005046334    0.006852755        0.736        0.4615
SPMDPCT    1   -0.00008483 0.0001224122        -0.693        0.4883  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1 0.0006544812       0.010700        0.061        0.9512
TCH2_DUM   1        0.013290   0.006307349        2.107        0.0351
TCH3_DUM   1  0.005175196       0.012374        0.418        0.6758
SURG_DUM   1  0.009462523    0.007641611        1.238        0.2156
TEFRA      1  0.008962789      0.0058144        1.541        0.1232
PPS_DUM    1        0.019739   0.005788358        3.410        0.0007
IPRDAY60   1  0.007881578 0.0003374003         23.360        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Pneumonia - 14 Day
PPS Trend

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                       SUM OF         MEAN
SOURCE       DF       SQUARES       SQUARE      F VALUE       PROB>F

MODEL        29     59.148481     2.039603       21.006       0.0001
ERROR     39759      3860.514     0.097098
C TOTAL39788         3919.662

    ROOT MSE         0.311605     R-SQUARE       0.0151
    DEP MEAN         0.110784     ADJ R-SQ       0.0144
    C.V.             281.2719

                    PARAMETER     STANDARD    T FOR H0:                    VARIABLE
VARIABLE   DF        ESTIMATE        ERROR  PARAMETER=0   PROB > !T!         LABEL

INTERCEP    1        0.210286     0.033572        6.264       0.0001  INTERCEPT
AGE         1 -0.000071968 0.0001901876          -0.378       0.7051  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1   -0.00424056   0.00732611         -0.579       0.5627
BED_DUM1    1      0.053765  0.008292629          6.484       0.0001
BED_DUM2    1      0.034644   0.00692572          5.002       0.0001
BED_DUM3    1      0.026530  0.005938698          4.467       0.0001
BED_DUM4    1      0.013426  0.005641342          2.380       0.0173
BED_DUM5    1   0.008820121  0.005798162          1.521       0.1282
CAPINC      1 -0.000965092 0.0005570225          -1.733       0.0832  MEAN PER CAPITA INCOME (TEBI)
EDUC        1   -0.00973175  0.002494865         -3.901       0.0001  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1     -0.024624  0.003155035         -7.805       0.0001
GOV_DUM     1    0.00695491  0.004246795          1.638       0.1015
HMOPOP      1 0.0003495979 0.0002340584           1.494       0.1353  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1   -0.00712746     0.013580         -0.525       0.5997
HOS_RUR     1   0.008739631  0.004633323          1.886       0.0593
ICCU_YN     1      0.024774   0.00528588          4.687       0.0001
LOS         1   0.001335313 0.0002844791          4.694       0.0001  LENGTH OF STAY
LOSSQRD     1 -.0000100097 .00000265437          -3.771       0.0002
NHBPOP      1 -.0000029014 .00000360825          -0.804       0.4213  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1     -0.011371  0.005902994         -1.926       0.0541
PHYSPOP     1 -.0000099534 .00001879657          -0.530       0.5964  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1   0.005875166  0.004961776          1.184       0.2364
SPMDPCT     1 -.0000207034 .00008857568          -0.234       0.8152  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1    -0.0011126  0.007735402         -0.144       0.8856
TCH2_DUM    1   0.008283058  0.004563789          1.815       0.0695
TCH3_DUM    1      0.015792  0.008953032          1.764       0.0778
SURG_DUM    1      0.013890  0.005516707          2.518       0.0118
TEFRA       1    0.00115203   0.00397272          0.290       0.7718
TREND1      1 0.0005333383  0.001966328           0.271       0.7862
IPRDAY60    1    0.00391588 0.0002441212         16.041       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Pneumonia - 30 Day
PPS Trend

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                                                         9:58 THURSDAY, SEPTEMBER 1, 1988    6

                      SUM OF         MEAN
SOURCE     DF        SQUARES       SQUARE      F VALUE      PROB>F

MODEL      29        130.520     4.500706       31.688      0.0001
ERROR   39759       5647.052     0.142032
C TOTAL39788        5777.573

    ROOT MSE        0.376871     R-SQUARE       0.0226
    DEP MEAN        0.176280     ADJ R-SQ       0.0219
    C.V.            213.7915

                   PARAMETER     STANDARD   T FOR H0:                   VARIABLE
VARIABLE   DF       ESTIMATE        ERROR  PARAMETER=0   PROB > |T|      LABEL

INTERCEP    1       0.278485     0.040604        6.859       0.0001 INTERCEPT
AGE         1 .00005840226 0.0002300226        0.254       0.7996 BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1      -0.019127  0.008860572       -2.159       0.0309
BED_DUM1    1       0.063708     0.010030        6.352       0.0001
BED_DUM2    1       0.045179   0.00837632        5.394       0.0001
BED_DUM3    1       0.039954  0.007182566        5.563       0.0001
BED_DUM4    1       0.024510  0.006822928        3.592       0.0003
BED_DUM5    1       0.016164  0.007012594        2.305       0.0212
CAPINC      1    -0.00163914 0.0006736915       -2.433       0.0150 MEAN PER CAPITA INCOME (TEBI)
EDUC        1      -0.010775  0.003017417       -3.571       0.0004 MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1      -0.036493  0.003815861       -9.564       0.0001
GOV_DUM     1       0.014121  0.005136291        2.749       0.0060
HMOPOP      1 0.0006686877 0.0002830823        2.362       0.0182 % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1    -0.00733346     0.016424       -0.447       0.6552
HOS_RUR     1       0.014714  0.005603778        2.626       0.0086
ICCU_YN     1       0.035742  0.006393014        5.591       0.0001
LOS         1    0.002480427 0.0003440635        7.209       0.0001 LENGTH OF STAY
LOSSQRD     1  -.0000174815 .00000321033       -5.445       0.0001
NHBPOP      1  -.0000087992  0.000004364       -2.016       0.0438 NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1      -0.017329  0.007139383       -2.427       0.0152
PHYSPOP     1 .00002640975 .00002273354        1.162       0.2454 PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1    0.006125412  0.006001026        1.021       0.3074
SPMDPCT     1   -0.000131189  0.000107128       -1.225       0.2207 % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1      -0.011677  0.009355592       -1.248       0.2120
TCH2_DUM    1       0.011888   0.00551968        2.154       0.0313
TCH3_DUM    1       0.011074     0.010828        1.023       0.3065
SURG_DUM    1       0.018712  0.006672188        2.804       0.0050
TEFRA       1    0.001434322  0.004804811        0.299       0.7653
TREND1      1    0.002872504  0.002378178        1.208       0.2271
IPRDAY60    1    0.006168343 0.0002952527       20.892       0.0001 TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Pneumonia - 60 Day
PPS Trend

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                                                                                    9:58 THURSDAY, SEPTEMBER 1, 1988    7

                      SUM OF          MEAN
SOURCE      DF       SQUARES        SQUARE       F VALUE       PROB>F

MODEL       29       185.392      6.392829        34.462       0.0001
ERROR    39759      7375.387      0.185502
C TOTAL39788        7560.779

    ROOT MSE        0.430700      R-SQUARE        0.0245
    DEP MEAN        0.255096      ADJ R-SQ        0.0238
    C.V.            168.8386

                   PARAMETER      STANDARD    T FOR H0:                    VARIABLE
VARIABLE    DF      ESTIMATE         ERROR  PARAMETER=0   PROB > !T!          LABEL

INTERCEP     1      0.377864      0.046404        8.143       0.0001  INTERCEPT
AGE          1  0.0002318122  0.0002628766        0.882       0.3779  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.030272      0.010126       -2.990       0.0028
BED_DUM1     1      0.060773      0.011462        5.302       0.0001
BED_DUM2     1      0.042366   0.009572707        4.426       0.0001
BED_DUM3     1      0.038845   0.008208449        4.732       0.0001
BED_DUM4     1      0.026578   0.007797445        3.409       0.0007
BED_DUM5     1      0.012505   0.008014201        1.560       0.1187
CAPINC       1   -0.00167425  0.0007699146       -2.175       0.0297  MEAN PER CAPITA INCOME (TEBI)
EDUC         1     -0.013496   0.003448394       -3.914       0.0001  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1     -0.039998   0.004360879       -9.172       0.0001
GOV_DUM      1      0.014069   0.005869906        2.397       0.0165
HMOPOP       1  0.0009245136  0.0003235148        2.858       0.0043  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1   -0.00698939      0.018770       -0.372       0.7096
HOS_RUR      1      0.013375   0.006404163        2.089       0.0368
ICCU_YN      1      0.033436   0.007306126        4.576       0.0001
LOS          1   0.003171985   0.000393206        8.067       0.0001  LENGTH OF STAY
LOSSQRD      1  -.0000220885  .00000366887       -6.021       0.0001
NHBPOP       1  -.0000076855  0.0000049873       -1.541       0.1233  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1     -0.026525   0.008159099       -3.251       0.0012
PHYSPOP      1  -.0000082743  .00002598056       -0.318       0.7501  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   0.004922053    0.00685815        0.718       0.4730
SPMDPCT      1  -.0000826559   0.000122429       -0.675       0.4996  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.002133567      0.010692        0.200       0.8418
TCH2_DUM     1      0.013397   0.006308054        2.124       0.0337
TCH3_DUM     1   0.005397618      0.012375        0.436       0.6627
SURG_DUM     1      0.011061   0.007625174        1.451       0.1469
TEFRA        1   0.003691841   0.005491081        0.672       0.5014
TREND1       1   0.005645924   0.002717852        2.077       0.0378
IPRDAY60     1   0.007889313  0.0003374235       23.381       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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General - 14 Day
PPS Dummy

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                                                                                    10:04 THURSDAY, SEPTEMBER 1, 1988     1

                         SUM OF          MEAN
SOURCE      DF          SQUARES        SQUARE         F VALUE        PROB>F

MODEL       29        88.795056      3.061898          29.818        0.0001
ERROR    42462         4360.271      0.102686
C TOTAL42491           4449.066

    ROOT MSE           0.320447      R-SQUARE          0.0200
    DEP MEAN           0.118822      ADJ R-SQ          0.0193
    C.V.               269.6859

                      PARAMETER      STANDARD     T FOR H0:                    VARIABLE
VARIABLE    DF         ESTIMATE         ERROR   PARAMETER=0    PROB > !T!        LABEL

INTERCEP     1         0.258978      0.036174         7.159        0.0001  INTERCEPT
AGE          1 -0.000605533 0.0002007384        -3.017        0.0026  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1   0.001571615   0.006784079         0.232        0.8168
BED_DUM1     1         0.023765   0.009227977         2.575        0.0100
BED_DUM2     1         0.015935   0.007075286         2.252        0.0243
BED_DUM3     1   0.003421264   0.005562514         0.615        0.5385
BED_DUM4     1     -0.00307939   0.005079052        -0.606        0.5443
BED_DUM5     1     -0.00238495   0.005116349        -0.466        0.6411
CAPINC       1 -0.000610073 0.0009313915        -0.655        0.5125  MEAN PER CAPITA INCOME (TEBI)
EDUC         1     -0.00437875   0.002770936        -1.580        0.1141  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1        -0.019856   0.003177812        -6.248        0.0001
GOV_DUM      1   0.007447545   0.004479672         1.663        0.0964
HMOPOP       1 0.0007432006 0.0002304234         3.225        0.0013  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1        -0.038487      0.014659        -2.625        0.0087
HOS_RUR      1   0.005565119   0.004927737         1.129        0.2588
ICCU_YN      1         0.040530   0.004158924         9.745        0.0001
LOS          1 0.0003503812 0.0002580905         1.358        0.1746  LENGTH OF STAY
LOSSQRD      1 -.0000063448 .00000262657        -2.416        0.0157
NHBPOP       1 .00000118357 .00000389009         0.304        0.7609  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1     -0.00496635    0.00551654        -0.900        0.3680
PHYSPOP      1 -.0000169567 .00001882725        -0.901        0.3678  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1         -0.00508   0.005023562        -1.011        0.3119
SPMDPCT      1 -0.000227684 .00008823072        -2.581        0.0099  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.006847467   0.004880087         1.403        0.1606
TCH2_DUM     1     -0.00633648   0.004163578        -1.522        0.1280
TCH3_DUM     1         0.015317    0.00735597         2.082        0.0373
SURG_DUM     1        -0.035745   0.003803447        -9.398        0.0001
TEFRA        1     -0.00166016   0.004246334        -0.391        0.6958
PPS_DUM      1         0.012978   0.004483634         2.895        0.0038
IPRDAY60     1   0.004646498 0.0002571666        18.068        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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General 30 Day
PPS Dummy

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                                                                                  10:04 THURSDAY, SEPTEMBER 1, 1988    2

                      SUM OF         MEAN
SOURCE      DF       SQUARES       SQUARE        F VALUE       PROB>F

MODEL       29       187.614     6.469458         43.128       0.0001
ERROR    42462      6369.568     0.150006
C TOTAL42491        6557.182

    ROOT MSE        0.387306     R-SQUARE         0.0286
    DEP MEAN        0.190671     ADJ R-SQ         0.0279
    C.V.             203.128

                   PARAMETER     STANDARD    T FOR H0:                     VARIABLE
VARIABLE    DF      ESTIMATE        ERROR  PARAMETER=0    PROB > |T|        LABEL

INTERCEP     1      0.408699     0.043722        9.348        0.0001  INTERCEPT
AGE          1   -0.00104481 0.0002426211       -4.306        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1   0.006810608  0.008199534        0.831        0.4062
BED_DUM1     1      0.022727     0.011153        2.038        0.0416
BED_DUM2     1      0.010662  0.008551499        1.247        0.2125
BED_DUM3     1 0.0003568396  0.006723097        0.053        0.9577
BED_DUM4     1   -0.00392982  0.006138763       -0.640        0.5221
BED_DUM5     1   -0.00254361  0.006183843       -0.411        0.6808
CAPINC       1 -0.000842692    0.00112572       -0.749        0.4541  MEAN PER CAPITA INCOME (TEBI)
EDUC         1   -0.00716536  0.003349073       -2.140        0.0324  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1     -0.028342  0.003840842       -7.379        0.0001
GOV_DUM      1   0.003566836  0.005414327        0.659        0.5100
HMOPOP       1 0.0009245045 0.0002784998        3.320        0.0009  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1     -0.042266     0.017717       -2.386        0.0171
HOS_RUR      1   0.003642106  0.005955877        0.612        0.5409
ICCU_YN      1      0.036976  0.005026657        7.356        0.0001
LOS          1 0.0006725569 0.0003119394        2.156        0.0311  LENGTH OF STAY
LOSSQRD      1 -.0000099445  .00000317459       -3.133        0.0017
NHBPOP       1 -9.84090E-07  .00000470173       -0.209        0.8342  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1   -0.00236753  0.006667531       -0.355        0.7225
PHYSPOP      1 -0.000035746  .00002275543       -1.571        0.1162  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   -0.00838462  0.006071695       -1.381        0.1673
SPMDPCT      1 -0.000244388 0.0001066395       -2.292        0.0219  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.009974285  0.005898285        1.691        0.0908
TCH2_DUM     1   -0.00726941  0.005032281       -1.445        0.1486
TCH3_DUM     1      0.022111  0.008890746        2.487        0.0129
SURG_DUM     1     -0.055724  0.004597012      -12.122        0.0001
TEFRA        1   -0.00960827  0.005132304       -1.872        0.0612
PPS_DUM      1      0.014996  0.005419115        2.767        0.0057
IPRDAY60     1   0.007896973 0.0003108228       25.407        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                     10:04 THURSDAY, SEPTEMBER 1, 1988    3
General - 60 Day
   PPS Dummy


                    SUM OF         MEAN
SOURCE     DF      SQUARES       SQUARE      F VALUE      PROB>F

MODEL      29      292.540    10.087601       52.851      0.0001
ERROR   42462     8104.732     0.190870
C TOTAL42491      8397.272

    ROOT MSE      0.436887     R-SQUARE       0.0348
    DEP MEAN      0.271133     ADJ R-SQ       0.0342
    C.V.          161.1336


                 PARAMETER     STANDARD    T FOR H0:                       VARIABLE
VARIABLE  DF      ESTIMATE        ERROR  PARAMETER=0    PROB > !T!           LABEL

INTERCEP   1      0.490643     0.049319        9.948        0.0001  INTERCEPT
AGE        1 -0.000954275 0.0002736799       -3.487        0.0005  BENEFICIARY AGE AS OF ADMISSION DATE
AGED       1    -0.0066648  0.009249186       -0.721        0.4712
BED_DUM1   1      0.034523     0.012581        2.744        0.0061
BED_DUM2   1      0.014937  0.009646207        1.548        0.1215
BED_DUM3   1   0.007551045  0.007583745        0.996        0.3194
BED_DUM4   1   0.002627638  0.006924608        0.379        0.7043
BED_DUM5   1 0.0002216041  0.006975459        0.032        0.9747
CAPINC     1   -0.00069742  0.001269828       -0.549        0.5829  MEAN PER CAPITA INCOME (TEBI)
EDUC       1   -0.00661386    0.0037778       -1.751        0.0800  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE     1     -0.035355  0.004332523       -8.160        0.0001
GOV_DUM    1   0.007936873  0.006107435        1.300        0.1938
HMOPOP     1 0.0006017928 0.0003141515        1.916        0.0554  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC     1     -0.042448     0.019986       -2.124        0.0337
HOS_RUR    1   0.001411974  0.006718311        0.210        0.8335
ICCU_YN    1      0.033802  0.005670138        5.961        0.0001
LOS        1   0.001247005 0.0003518719        3.544        0.0004  LENGTH OF STAY
LOSSQRD    1 -.0000142087 .00000358098       -3.968        0.0001
NHBPOP     1 -.0000115138 .00000530361       -2.171        0.0299  NURSING HOME BEDS PER 100K POPULATION
NONWHITE   1 0.0005514682  0.007521066        0.073        0.9415
PHYSPOP    1 -.0000115894 .00002566843       -0.452        0.6516  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM   1   -0.00436117  0.006848955       -0.637        0.5243
SPMDPCT    1   -0.00032465 0.0001202908       -2.699        0.0070  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN    1   0.006145025  0.006653346        0.924        0.3557
TCH2_DUM   1 0.0001258925  0.005676482        0.022        0.9823
TCH3_DUM   1      0.034824     0.010029        3.472        0.0005
SURG_DUM   1     -0.077362  0.005185492      -14.919        0.0001
TEFRA      1   -0.00609959  0.005789309       -1.054        0.2921
PPS_DUM    1      0.022911  0.006112836        3.748        0.0002
IPRDAY60   1   0.009964981 0.0003506124       28.422        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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General  - 14 Day                                                                          10:04 THURSDAY, SEPTEMBER 1, 1988    5
     PPS Trend


                     SUM OF          MEAN
SOURCE     DF       SQUARES        SQUARE       F VALUE       PROB>F

MODEL      29     88.756686      3.060575        29.805       0.0001
ERROR   42462      4360.309      0.102687
C TOTAL42491       4449.066

    ROOT MSE       0.320449      R-SQUARE        0.0199
    DEP MEAN       0.118822      ADJ R-SQ        0.0193
    C.V.           269.6871


                  PARAMETER      STANDARD    T FOR H0:                     VARIABLE
VARIABLE   DF      ESTIMATE         ERROR  PARAMETER=0    PROB > !T!        LABEL

INTERCEP    1      0.262967      0.036029        7.299        0.0001  INTERCEPT
AGE         1  -0.000600765  0.0002006977       -2.993        0.0028  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1   0.001488782   0.006783602        0.219        0.8263
BED_DUM1    1      0.023437   0.009221761        2.542        0.0110
BED_DUM2    1      0.015847   0.007074148        2.240        0.0251
BED_DUM3    1   0.003399456   0.005562439        0.611        0.5411
BED_DUM4    1   -0.00298648   0.005079711       -0.588        0.5566
BED_DUM5    1   -0.00238231   0.005116396       -0.466        0.6415
CAPINC      1  -0.000434599  0.0009124787       -0.476        0.6339  MEAN PER CAPITA INCOME (TEBI)
EDUC        1   -0.00448487   0.002768285       -1.620        0.1052  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1     -0.019801    0.00317765       -6.231        0.0001
GOV_DUM     1   0.007367314   0.004479777        1.645        0.1001
HMOPOP      1  0.0007302624  0.0002303607        3.170        0.0015  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1     -0.042041      0.014376       -2.924        0.0035
HOS_RUR     1    0.00567007   0.004925501        1.151        0.2497
ICCU_YN     1      0.040530   0.004159098        9.745        0.0001
LOS         1   0.000339234  0.0002578576        1.316        0.1883  LENGTH OF STAY
LOSSQRD     1  -0.000006292  .00000262604       -2.396        0.0166
NHBPOP      1  .00000102257  .00000388972        0.263        0.7926  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1   -0.00478823   0.005514108       -0.868        0.3852
PHYSPOP     1  -.0000178285  .00001880342       -0.948        0.3431  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1   -0.00550609    0.00502791       -1.095        0.2735
SPMDPCT     1  -0.000227712  0.0000882317       -2.581        0.0099  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1   0.007637495   0.004835904        1.579        0.1143
TCH2_DUM    1   -0.00626887   0.004163098       -1.506        0.1321
TCH3_DUM    1      0.015841   0.007352603        2.154        0.0312
SURG_DUM    1     -0.035651   0.003802441       -9.376        0.0001
TEFRA       1   -0.00364086   0.003949049       -0.922        0.3566
TREND1      1   0.005782124   0.002043662        2.829        0.0047
IPRDAY60    1   0.004652744  0.0002571529       18.093        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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                                                                              10:04 THURSDAY, SEPTEMBER 1, 1988    6
     General - 30 Day
         PPS Trend

                       SUM OF          MEAN
SOURCE       DF       SQUARES        SQUARE      F VALUE        PROB>F

MODEL        29       187.497      6.465428       43.100        0.0001
ERROR     42462      6369.685      0.150009
C TOTAL42491         6557.182

    ROOT MSE         0.387310      R-SQUARE       0.0286
    DEP MEAN         0.190671      ADJ R-SQ       0.0279
    C.V.             203.1298

                    PARAMETER      STANDARD    T FOR H0:                      VARIABLE
VARIABLE     DF      ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP      1      0.413645      0.043546        9.499        0.0001  INTERCEPT
AGE           1   -0.00103884  0.0002425731       -4.283        0.0001  BENEFICIARY AGE AS OF ADMISSION DATE
AGED          1   0.006703016   0.008198997        0.818        0.4136
BED_DUM1      1      0.022297      0.011146        2.000        0.0455
BED_DUM2      1      0.010524   0.008550164        1.231        0.2184
BED_DUM3      1  0.0003093513   0.006723038        0.046        0.9633
BED_DUM4      1   -0.00383346    0.00613959       -0.624        0.5324
BED_DUM5      1   -0.00254629   0.006183929       -0.412        0.6805
CAPINC        1  -0.000610505   0.001102867       -0.554        0.5799  MEAN PER CAPITA INCOME (TEBI)
EDUC          1   -0.00730945   0.003345885       -2.185        0.0289  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE        1     -0.028277   0.003840664       -7.362        0.0001
GOV_DUM       1   0.003476872   0.005414479        0.642        0.5208
HMOPOP        1  0.0009094475  0.0002784254        3.266        0.0011  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC        1     -0.046667      0.017375       -2.686        0.0072
HOS_RUR       1   0.003802296   0.005953203        0.639        0.5230
ICCU_YN       1      0.036992   0.005026891        7.359        0.0001
LOS           1  0.0006581385  0.0003116595        2.112        0.0347  LENGTH OF STAY
LOSSQRD       1  -.0000098756  .00000317396       -3.111        0.0019
NHBPOP        1  -.0000011701  0.0000047013       -0.249        0.8035  NURSING HOME BEDS PER 100K POPULATION
NONWHITE      1   -0.00214084   0.006664623       -0.321        0.7480
PHYSPOP       1  -.0000369081  .00002272675       -1.624        0.1044  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM      1   -0.00885522   0.006076981       -1.457        0.1451
SPMDPCT       1  -0.000244596  0.0001066412       -2.294        0.0218  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN       1      0.010957   0.005844912        1.875        0.0608
TCH2_DUM      1   -0.00718274   0.005031726       -1.427        0.1534
TCH3_DUM      1      0.022720   0.008886718        2.557        0.0106
SURG_DUM      1     -0.055603   0.004595817      -12.099        0.0001
TEFRA         1     -0.012051   0.004773016       -2.525        0.0116
TREND1        1   0.006478286   0.002470071        2.623        0.0087
IPRDAY60      1   0.007904262  0.0003108077       25.431        0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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General - 60 Day
PPS Trend

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                                                                                                  10:04 THURSDAY, SEPTEMBER 1, 1988    7

                    SUM OF         MEAN
SOURCE     DF      SQUARES       SQUARE       F VALUE       PROB>F

MODEL      29      292.015    10.069470        52.752       0.0001
ERROR   42462     8105.258     0.190883
C TOTAL42491      8397.272

    ROOT MSE      0.436901     R-SQUARE        0.0348
    DEP MEAN      0.271133     ADJ R-SQ        0.0341
    C.V.          161.1388

                 PARAMETER     STANDARD   T FOR H0:                   VARIABLE
VARIABLE   DF     ESTIMATE        ERROR  PARAMETER=0   PROB > !T!      LABEL

INTERCEP    1     0.499088     0.049122       10.160       0.0001  INTERCEPT
AGE         1 -0.000943942 0.0002736321       -3.450       0.0006  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1  -0.00686045  0.009248795       -0.742       0.4582
BED_DUM1    1     0.033730     0.012573        2.683       0.0073
BED_DUM2    1     0.014632  0.009644926        1.517       0.1293
BED_DUM3    1   0.00741981  0.007583854        0.978       0.3279
BED_DUM4    1  0.002745875  0.006925702        0.396       0.6918
BED_DUM5    1 0.0002023808  0.006975719        0.029       0.9769
CAPINC      1 -0.000265214  0.001244078       -0.213       0.8312  MEAN PER CAPITA INCOME (TEBI)
EDUC        1  -0.00689049  0.003774292       -1.826       0.0679  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1    -0.035250  0.004332422       -8.136       0.0001
GOV_DUM     1  0.007806648  0.006107749        1.278       0.2012
HMOPOP      1  0.000578508 0.0003140749        1.842       0.0655  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1    -0.049946     0.019600       -2.548       0.0108
HOS_RUR     1  0.001759179  0.006715451        0.262       0.7934
ICCU_YN     1     0.033871  0.005670533        5.973       0.0001
LOS         1  0.001220928 0.0003515643        3.473       0.0005  LENGTH OF STAY
LOSSQRD     1 -.0000140826 .00000358035       -3.933       0.0001
NHBPOP      1 -.0000117977 .00000530326       -2.225       0.0261  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1 0.0009527261   0.00751796        0.127       0.8992
PHYSPOP     1 -.0000137719 .00002563668       -0.537       0.5911  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1  -0.00502287  0.006855076       -0.733       0.4637
SPMDPCT     1 -0.000325426 0.0001202955       -2.705       0.0068  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1  0.007831807  0.006593294        1.188       0.2349
TCH2_DUM    1 0.0002807937  0.005675988        0.049       0.9605
TCH3_DUM    1     0.035768     0.010025        3.568       0.0004
SURG_DUM    1    -0.077147  0.005184265      -14.881       0.0001
TEFRA       1    -0.010237  0.005384152       -1.901       0.0573
TREND1      1  0.009362962  0.002786338        3.360       0.0008
IPRDAY60    1  0.009976304 0.0003506035       28.455       0.0001  TOTAL INPAT DAYS IN PRE 60 DAY PERIOD
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Hip Complication - 14 Day                                                      13:56 WEDNESDAY, OCTOBER 5, 1988    1
      PPS Dummy

DEP VARIABLE: RE_14_YN
                      SUM OF        MEAN
SOURCE     DF        SQUARES      SQUARE      F VALUE       PROB>F

MODEL       27      1.116625    0.041356        1.807       0.0063
ERROR    24019       549.655    0.022884
C TOTAL24046         550.772

     ROOT MSE       0.151275    R-SQUARE       0.0020
     DEP MEAN       0.023454    ADJ R-SQ       0.0009
     C.V.           644.9849

                   PARAMETER     STANDARD   T FOR HO:                   VARIABLE
VARIABLE   DF       ESTIMATE        ERROR  PARAMETER=0  PROB > |T|        LABEL

INTERCEP    1       0.074072     0.024773        2.990      0.0028  INTERCEPT
AGE         1 0.0001601282 0.0001295204        1.236      0.2164  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1    -0.00448559  0.005302159       -0.846      0.3976
BED_DUM1    1   0.009293637  0.008838739        1.051      0.2931
BED_DUM2    1     -0.0031101  0.004912977       -0.633      0.5267
BED_DUM3    1   0.001626689  0.003402069        0.478      0.6325
BED_DUM4    1    0.00180286  0.003021091        0.597      0.5507
BED_DUM5    1   -0.00298493  0.003001241       -0.995      0.3200
CAPINC      1 -0.000491397  0.000572862       -0.858      0.3910  MEAN PER CAPITA INCOME (TEBI)
EDUC        1   -0.00296974  0.001889384       -1.572      0.1160  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1   -0.00675696  0.002237094       -3.020      0.0025
GOV_DUM     1   -0.00228844  0.003101657       -0.738      0.4606
HMOPOP      1 .00004092329 0.0001334065        0.307      0.7590  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1     -0.011807  0.009890002       -1.194      0.2325
HOS_RUR     1   -0.00360719  0.003153304       -1.144      0.2527
ICCU_YN     1   0.003993663  0.002894793        1.380      0.1677
LOS         1 -0.000350926 0.0001343928       -2.611      0.0090  LENGTH OF STAY
LOSSQRD     1   8.47227E-07   6.12023E-07        1.384      0.1663
NHBPOP      1 -.0000026101  .00000248756       -1.049      0.2941  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1 -.0000274384  0.004935133       -0.006      0.9956
PHYSPOP     1 -.0000086969  .00001130305       -0.769      0.4416  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1    -0.0019909  0.003310135       -0.601      0.5475
SPMDPCT     1 -.0000025712  .00005630343       -0.046      0.9636  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1   0.004723457  0.002403799        1.965      0.0494
TCH2_DUM    1 0.0004212473  0.002458222        0.171      0.8639
TCH3_DUM    1   -0.00360936  0.004535668       -0.796      0.4262
TEFRA       1   0.005285055  0.002843422        1.859      0.0631
PPS_DUM     1   0.003964172  0.002988964        1.326      0.1848
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  Hip Complication - 30 Day                                                                        13:56 WEDNESDAY, OCTOBER 5, 1988    2
        PPS Dummy

DEP VARIABLE: RE_30_YN
                          SUM OF          MEAN
SOURCE       DF          SQUARES        SQUARE       F VALUE       PROB>F

MODEL        27         1.882098      0.069707         2.147       0.0005
ERROR     24019          779.901      0.032470
C TOTAL24046             781.783

    ROOT MSE            0.180195      R-SQUARE        0.0024
    DEP MEAN            0.033642      ADJ R-SQ        0.0013
    C.V.                535.6174

                       PARAMETER      STANDARD    T FOR HO:                       VARIABLE
VARIABLE    DF          ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP     1          0.097050      0.029509        3.289        0.0010  INTERCEPT
AGE          1  0.0003205651  0.0001542811            2.078        0.0377  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.00625346   0.006315785         -0.990        0.3221
BED_DUM1     1    0.004463081       0.010528          0.424        0.6716
BED_DUM2     1  0.0004260626     0.005852202          0.073        0.9420
BED_DUM3     1   .00002606667     0.00405245          0.006        0.9949
BED_DUM4     1   -0.000733972     0.00359864         -0.204        0.8384
BED_DUM5     1     -0.00406065   0.003574995         -1.136        0.2560
CAPINC       1   -0.000721675  0.0006823774         -1.058        0.2903  MEAN PER CAPITA INCOME (TEBI)
EDUC         1     -0.00424346   0.002250581         -1.885        0.0594  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1     -0.00934244   0.002664764         -3.506        0.0005
GOV_DUM      1     -0.00220463   0.003694607         -0.597        0.5507
HMOPOP       1  -.0000225987  0.0001589101           -0.142        0.8869  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1       -0.017905      0.011781         -1.520        0.1285
HOS_RUR      1      -0.0076116   0.003756129         -2.026        0.0427
ICCU_YN      1    0.004827975    0.003448197          1.400        0.1615
LOS          1   -0.000202665    0.000160085         -1.266        0.2055  LENGTH OF STAY
LOSSQRD      1     3.76620E-07    7.29024E-07         0.517        0.6054
NHBPOP       1  -.0000054878   .00000296312          -1.852        0.0640  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1     -0.00236947   0.005878594         -0.403        0.6869
PHYSPOP      1  -.0000067188    .00001346388         -0.499        0.6178  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1  0.0006480731     0.003942941          0.164        0.8694
SPMDPCT  ,   1  -.0000128154   .00006706709          -0.191        0.8485  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1      0.00461173   0.002863339          1.611        0.1073
TCH2_DUM     1   -0.000875708    0.002928166         -0.299        0.7649
TCH3_DUM     1     -0.00376799   0.005402762         -0.697        0.4855
TEFRA        1     0.007522706   0.003387006          2.221        0.0264
PPS_DUM      1     0.008492693   0.003560371          2.385        0.0171
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     Hip Complication - 60 Day                                                          13:56 WEDNESDAY, OCTOBER 5, 1988    3
             PPS Dummy

DEP VARIABLE: RE_60_YN

                     SUM OF          MEAN
SOURCE      DF      SQUARES        SQUARE       F VALUE       PROB>F

MODEL       27     2.942314      0.108975         2.739       0.0001
ERROR    24019      955.472      0.039780
C TOTAL24046        958.415

    ROOT MSE       0.199449      R-SQUARE        0.0031
    DEP MEAN       0.041585      ADJ R-SQ        0.0019
    C.V.           479.6147

                  PARAMETER      STANDARD    T FOR HO:                   VARIABLE
VARIABLE   DF      ESTIMATE         ERROR  PARAMETER=0    PROB > |T|       LABEL

INTERCEP    1      0.119035      0.032662        3.645        0.0003  INTERCEPT
AGE         1  0.0004645559  0.0001707663        2.720        0.0065  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1     -0.013813   0.006990635       -1.976        0.0482
BED_DUM1    1   0.001139326      0.011653        0.098        0.9221
BED_DUM2    1   -0.00236873   0.006477517       -0.366        0.7146
BED_DUM3    1   0.001822311    0.00448546        0.406        0.6845
BED_DUM4    1  -0.000345208   0.003983159       -0.087        0.9309
BED_DUM5    1   -0.00169245   0.003956988       -0.428        0.6689
CAPINC      1  -0.000719813  0.0007552903       -0.953        0.3406  MEAN PER CAPITA INCOME (TEBI)
EDUC        1   -0.00588612   0.002491059       -2.363        0.0181  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1     -0.012745   0.002949498       -4.321        0.0001
GOV_DUM     1   -0.00107297   0.004089381       -0.262        0.7930
HMOPOP      1   -0.00018396  0.0001758899       -1.046        0.2956  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1     -0.015747      0.013039       -1.208        0.2272
HOS_RUR     1   -0.00619436   0.004157476       -1.490        0.1363
ICCU_YN     1   0.005471209   0.003816642        1.434        0.1517
LOS         1  -.0000165482  0.0001771903       -0.093        0.9256  LENGTH OF STAY
LOSSQRD     1  -1.54131E-07   8.06922E-07       -0.191        0.8485
NHBPOP      1  -.0000059291  .00000327973       -1.808        0.0707  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1  -0.000393606    0.00650673       -0.060        0.9518
PHYSPOP     1  -.0000107417  .00001490251       -0.721        0.4710  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1   -0.00257105    0.00436425       -0.589        0.5558
SPMDPCT     1  -.0000370729  0.0000742333       -0.499        0.6175  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1   0.006305568   0.003169291        1.990        0.0466
TCH2_DUM    1   -0.00064133   0.003241044       -0.198        0.8431
TCH3_DUM    1   -0.00481132   0.005980055       -0.805        0.4211
TEFRA       1   0.009871398   0.003748912        2.633        0.0085
PPS_DUM     1      0.012116   0.003940801        3.074        0.0021
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Hip Complication - 14 Day
PPS Trend

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                                                                    13:56 WEDNESDAY, OCTOBER 5, 1988    5

DEP VARIABLE: RE_14_YN

                      SUM OF          MEAN
SOURCE       DF      SQUARES        SQUARE       F VALUE        PROB>F

MODEL        27     1.085063      0.040188         1.756        0.0090
ERROR     24019      549.687      0.022886
C TOTAL24046         550.772

    ROOT MSE        0.151280      R-SQUARE        0.0020
    DEP MEAN        0.023454      ADJ R-SQ        0.0008
    C.V.            645.0034

                   PARAMETER      STANDARD    T FOR HO:                     VARIABLE
VARIABLE     DF     ESTIMATE         ERROR  PARAMETER=0     PROB > |T|        LABEL

INTERCEP      1     0.077632      0.024602        3.155        0.0016  INTERCEPT
AGE           1 0.0001616204   0.000129524        1.248        0.2121  BENEFICIARY AGE AS OF ADMISSION DATE
AGED          1  -0.00450423   0.005302301       -0.849        0.3956
BED_DUM1      1  0.008919278   0.008837047        1.009        0.3128
BED_DUM2      1  -0.00338928   0.004908367       -0.691        0.4899
BED_DUM3      1  0.001450201    0.00339923        0.427        0.6697
BED_DUM4      1  0.001776296   0.003021179        0.588        0.5566
BED_DUM5      1  -0.00304493   0.003001132       -1.015        0.3103
CAPINC        1 -0.000317289  0.0005595336       -0.567        0.5707  MEAN PER CAPITA INCOME (TEBI)
EDUC          1  -0.00308545    0.00188802       -1.634        0.1022  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE        1  -0.00674406   0.002237266       -3.014        0.0026
GOV_DUM       1  -0.00233645   0.003101528       -0.753        0.4513
HMOPOP        1 .00003302885  0.0001332409        0.248        0.8042  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC        1    -0.014373   0.009667039       -1.487        0.1371
HOS_RUR       1  -0.00347131   0.003153626       -1.101        0.2710
ICCU_YN       1  0.004010353   0.002895274        1.385        0.1660
LOS           1 -0.000369088   0.000133721       -2.760        0.0058  LENGTH OF STAY
LOSSQRD       1  9.03256E-07   6.10433E-07        1.480        0.1390
NHBPOP        1 -.0000025964  .00000248829       -1.043        0.2968  NURSING HOME BEDS PER 100K POPULATION
NONWHITE      1 0.0002280628   0.004930499        0.046        0.9631
PHYSPOP       1 -.0000095065  .00001128997       -0.842        0.3998  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM      1  -0.00208045   0.003314132       -0.628        0.5302
SPMDPCT       1 -.0000050552  .00005627378       -0.090        0.9284  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN       1  0.005298829   0.002358366        2.247        0.0247
TCH2_DUM      1 0.0004477135   0.002458759        0.182        0.8555
TCH3_DUM      1  -0.00345497   0.004533943       -0.762        0.4461
TEFRA         1  0.003728233   0.002535339        1.471        0.1414
TREND1        1 0.0007875055    0.00127789        0.616        0.5377
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Hip Complication - 30 Day                                                                          13:56 WEDNESDAY, OCTOBER 5, 1988    6
      PPS Trend

DEP VARIABLE: RE_30_YN
                       SUM OF          MEAN
SOURCE      DF        SQUARES        SQUARE       F VALUE       PROB>F

MODEL       27       1.806815      0.066919         2.061       0.0010
ERROR    24019        779.976      0.032473
C TOTAL24046          781.783

     ROOT MSE        0.180204      R-SQUARE        0.0023
     DEP MEAN        0.033642      ADJ R-SQ        0.0012
     C.V.            535.6433

                    PARAMETER      STANDARD    T FOR HO:                       VARIABLE
VARIABLE    DF       ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP     1       0.102454      0.029306        3.496        0.0005   INTERCEPT
AGE          1    0.000321951   0.0001542884       2.087        0.0369   BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1    -0.00627445    0.006316077      -0.993        0.3205
BED_DUM1     1    0.004059873       0.010527       0.386        0.6997
BED_DUM2     1  .00003327526    0.005846825        0.006        0.9955
BED_DUM3     1   -0.000233624    0.004049148      -0.058        0.9540
BED_DUM4     1     -0.0007583    0.003598815      -0.211        0.8331
BED_DUM5     1    -0.00412878    0.003574935      -1.155        0.2481
CAPINC       1    -0.00049724   0.0006665139      -0.746        0.4557   MEAN PER CAPITA INCOME (TEBI)
EDUC         1    -0.00438195    0.002249001      -1.948        0.0514   MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1    -0.00929575    0.002665021      -3.488        0.0005
GOV_DUM      1    -0.00227135    0.003694526      -0.615        0.5387
HMOPOP       1  -.0000365088   0.0001587159       -0.230        0.8181   % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1      -0.021784       0.011515      -1.892        0.0585
HOS_RUR      1    -0.00749242    0.003756586      -1.994        0.0461
ICCU_YN      1    0.004906285    0.003448838       1.423        0.1549
LOS          1   -0.000227083   0.0001592879      -1.426        0.1540   LENGTH OF STAY
LOSSQRD      1    4.57662E-07    7.27146E-07       0.629        0.5291
NHBPOP       1  -.0000055207   .00000296404       -1.863        0.0625   NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1    -0.00193529    0.005873188      -0.330        0.7418
PHYSPOP      1  -.0000077331   .00001344856       -0.575        0.5653   PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   0.0003167464    0.003947779       0.080        0.9361
SPMDPCT      1  -.0000162187   .00006703308       -0.242        0.8088   % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1    0.005471932    0.002809275       1.948        0.0514
TCH2_DUM     1   -0.000881071    0.002928862      -0.301        0.7636
TCH3_DUM     1    -0.00347626    0.005400812      -0.644        0.5198
TEFRA        1    0.005099774    0.003020085       1.689        0.0913
TREND1       1    0.002794825    0.001522217       1.836        0.0664
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Hip Complication - 60 Day
PPS Trend

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DEP VARIABLE: RE_60_YN

                    SUM OF         MEAN
SOURCE     DF      SQUARES       SQUARE      F VALUE       PROB>F

MODEL       27    2.782930     0.103071        2.591       0.0001
ERROR    24019     955.632     0.039786
C TOTAL24046       958.415

     ROOT MSE     0.199466     R-SQUARE       0.0029
     DEP MEAN     0.041585     ADJ R-SQ       0.0018
     C.V.         479.6547

                  PARAMETER     STANDARD    T FOR HO:                     VARIABLE
VARIABLE   DF      ESTIMATE        ERROR  PARAMETER=0     PROB > |T|        LABEL

INTERCEP    1      0.126857     0.032439        3.911         0.0001  INTERCEPT
AGE         1 0.0004666237 0.0001707804         2.732         0.0063  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1     -0.013844  0.006991204       -1.980         0.0477
BED_DUM1    1 0.0005441078     0.011652         0.047         0.9628
BED_DUM2    1   -0.00293938  0.006471794       -0.454         0.6497
BED_DUM3    1   0.001445893  0.004481962        0.323         0.7470
BED_DUM4    1 -0.000381547   0.003983493       -0.096         0.9237
BED_DUM5    1   -0.00179267  0.003957061       -0.453         0.6505
CAPINC      1   -0.00039218 0.0007377578       -0.532         0.5950  MEAN PER CAPITA INCOME (TEBI)
EDUC        1   -0.00608917  0.002489398       -2.446         0.0145  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1     -0.012679  0.002949886       -4.298         0.0001
GOV_DUM     1   -0.00116997  0.004089435       -0.286         0.7748
HMOPOP      1 -0.000203955 0.0001756811        -1.161         0.2457  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1     -0.021361     0.012746       -1.676         0.0938
HOS_RUR     1   -0.00601571  0.004158128       -1.447         0.1480
ICCU_YN     1   0.005580796  0.003817485        1.462         0.1438
LOS         1 -.0000521107 0.0001763142        -0.296         0.7676  LENGTH OF STAY
LOSSQRD     1  -3.65595E-08   8.04870E-07      -0.045         0.9638
NHBPOP      1 -.0000059729  .00000328087       -1.821         0.0687  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1 0.0002314844   0.006500975        0.036         0.9716
PHYSPOP     1 -.0000122249  .00001488608       -0.821         0.4115  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1   -0.00303674  0.004369758       -0.695         0.4871
SPMDPCT     1 -.0000420243  .00007419826       -0.566         0.5711  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1   0.007551428  0.003109559        2.428         0.0152
TCH2_DUM    1  -0.000645871  0.003241929       -0.199         0.8421
TCH3_DUM    1   -0.00439317  0.005978107       -0.735         0.4624
TEFRA       1   0.006369035  0.003342903        1.905         0.0568
TREND1      1   0.003931671  0.001684928        2.333         0.0196
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Hernia Complication - 14 Day                                                        16:17 WEDNESDAY, OCTOBER 5, 1988     1
        PPS Dummy

DEP VARIABLE: RE_14_YN

                     SUM OF          MEAN
SOURCE     DF       SQUARES        SQUARE       F VALUE       PROB>F

MODEL       27     0.446216      0.016527         2.540       0.0001
ERROR   26037       169.432   0.006507352
C TOTAL26064        169.878

    ROOT MSE       0.080668      R-SQUARE        0.0026
    DEP MEAN    0.006560522      ADJ R-SQ        0.0016
    C.V.             1229.6

                  PARAMETER      STANDARD    T FOR HO:                    VARIABLE
VARIABLE   DF      ESTIMATE         ERROR  PARAMETER=0   PROB > |T|        LABEL

INTERCEP    1     -0.012274      0.013315       -0.922       0.3566   INTERCEPT
AGE         1  .00006504674  0.0000766504        0.849       0.3961   BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1    -0.0036501     0.0025511       -1.431       0.1525
BED_DUM1    1  -0.000979494   0.003091355       -0.317       0.7514
BED_DUM2    1   -0.00176209   0.002303198       -0.765       0.4442
BED_DUM3    1    -0.0022255   0.001791273       -1.242       0.2141
BED_DUM4    1   -0.00202142     0.0016009       -1.263       0.2067
BED_DUM5    1  -0.000755975   0.001626272       -0.465       0.6420
CAPINC      1  .00008533831  0.0001159005        0.736       0.4616   MEAN PER CAPITA INCOME (TEBI)
EDUC        1   0.001028937   0.001008055        1.021       0.3074   MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1   -0.00189776   0.001600383       -1.186       0.2357
GOV_DUM     1   0.002221152    0.00154489        1.438       0.1505
HMOPOP      1  -.0000021449  .00007277639       -0.029       0.9765   % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1   -0.00245031   0.004725562       -0.519       0.6041
HOS_RUR     1    0.00038178   0.001588552        0.240       0.8101
ICCU_YN     1   -0.00121667   0.002671526       -0.455       0.6488
LOS         1  0.0002635587  0.0001547812        1.703       0.0886   LENGTH OF STAY
LOSSQRD     1  -.0000027817  .00000207213       -1.342       0.1795
NHBPOP      1  0.0000035496  .00000130077        2.729       0.0064   NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1   0.005554537     0.0022157        2.507       0.0122
PHYSPOP     1  -1.40960E-07  .00000571827       -0.025       0.9803   PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1    0.00256245   0.001676127        1.529       0.1263
SPMDPCT     1  .00000870017  .00002984944        0.291       0.7707   % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1   0.005771685   0.001210091        4.770       0.0001
TCH2_DUM    1   -0.00118037   0.001325177       -0.891       0.3731
TCH3_DUM    1   0.001568389   0.002511559        0.624       0.5323
TEFRA       1  0.0009559364   0.001336139        0.715       0.4743
PPS_DUM     1   0.001478288   0.001397337        1.058       0.2901
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Hernia Complication - 30 Day                                                                        16:17 WEDNESDAY, OCTOBER 5, 1988    2
        PPS Dummy

DEP VARIABLE: RE_30_YN

                        SUM OF          MEAN
SOURCE      DF         SQUARES        SQUARE        F VALUE        PROB>F

MODEL       27        0.592126      0.021931          2.312        0.0001
ERROR    26037         247.010   0.009486885
C TOTAL26064           247.602

    ROOT MSE          0.097401      R-SQUARE         0.0024
    DEP MEAN       0.009591406      ADJ R-SQ         0.0014
    C.V.              1015.499

                     PARAMETER      STANDARD    T FOR HO:                          VARIABLE
VARIABLE    DF        ESTIMATE         ERROR  PARAMETER=0   PROB > |T|              LABEL

INTERCEP     1       -0.024727      0.016076       -1.538       0.1240  INTERCEPT
AGE          1  .00007862226 0.0000925495          0.850       0.3956  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.00595487   0.003080258       -1.933       0.0532
BED_DUM1     1     -0.00263111   0.003732574       -0.705       0.4809
BED_DUM2     1     0.002256855   0.002780936        0.812       0.4171
BED_DUM3     1     -0.00058349   0.002162826       -0.270       0.7873
BED_DUM4     1  -0.000534039     0.001932965       -0.276       0.7823
BED_DUM5     1  -0.000870548     0.001963599       -0.443       0.6575
CAPINC       1  .00009967524     0.000139941        0.712       0.4763  MEAN PER CAPITA INCOME (TEBI)
EDUC         1     0.001916643    0.00121715        1.575       0.1153  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1     -0.00343829   0.001932341       -1.779       0.0752
GOV_DUM      1     0.002733417   0.001865337        1.465       0.1428
HMOPOP       1  0.0000736236   .00008787193        0.838       0.4021  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1     0.002030386   0.005705755        0.356       0.7220
HOS_RUR      1     0.002277371   0.001918055        1.187       0.2351
ICCU_YN      1     -0.00125104   0.003225664       -0.388       0.6981
LOS          1  0.0004274823  0.0001868864         2.287       0.0222  LENGTH OF STAY
LOSSQRD      1  -0.000004536   .00000250194       -1.813       0.0698
NHBPOP       1  .00000293027   .00000157058        1.866       0.0621  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1     0.003904958   0.002675289        1.460       0.1444
PHYSPOP      1  -.0000013239   .00000690438       -0.192       0.8479  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1     0.003405481   0.002023796        1.683       0.0924
SPMDPCT      1  .00001289516   .00003604092        0.358       0.7205  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1     0.005145886   0.001461093        3.522       0.0004
TCH2_DUM     1  -0.000865565    0.00160005        -0.541       0.5885
TCH3_DUM     1     0.005409144   0.003032515        1.784       0.0745
TEFRA        1  0.0009826392    0.001613286         0.609       0.5425
PPS_DUM      1     0.002433093   0.001687178        1.442       0.1493
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Hernia Complication - 60 Day                                                                  16:17 WEDNESDAY, OCTOBER 5, 1988    3
         PPS Dummy

DEP VARIABLE: RE_60_YN

                      SUM OF        MEAN
SOURCE      DF       SQUARES       SQUARE       F VALUE       PROB>F

MODEL       27      0.992874     0.036773         2.604       0.0001
ERROR    26037       367.641     0.014120
C TOTAL26064         368.634

     ROOT MSE       0.118827     R-SQUARE        0.0027
     DEP MEAN       0.014349     ADJ R-SQ        0.0017
     C.V.           828.1375

                   PARAMETER      STANDARD    T FOR HO:                       VARIABLE
VARIABLE    DF      ESTIMATE         ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP     1     -0.024216      0.019613       -1.235        0.2169  INTERCEPT
AGE          1 0.0000667771   0.000112909        0.591        0.5542  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.013403   0.003757869       -3.567        0.0004
BED_DUM1     1   0.002657474   0.004553685        0.584        0.5595
BED_DUM2     1   0.001660309     0.0033927        0.489        0.6246
BED_DUM3     1 0.0004995205   0.002638615        0.189        0.8499
BED_DUM4     1   0.000880341   0.002358188        0.373        0.7089
BED_DUM5     1 0.0008652075   0.002395562        0.361        0.7180
CAPINC       1 .00009400807 0.0001707259        0.551        0.5819  MEAN PER CAPITA INCOME (TEBI)
EDUC         1   0.001877513   0.001484904        1.264        0.2061  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1   -0.00485077   0.002357427       -2.058        0.0396
GOV_DUM      1   0.005167481   0.002275683        2.271        0.0232
HMOPOP       1 .00006888442 0.0001072024        0.643        0.5205  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1      0.010665   0.006960935        1.532        0.1255
HOS_RUR      1    0.00245887   0.002339998        1.051        0.2934
ICCU_YN      1   -0.00454546   0.003935261       -1.155        0.2481
LOS          1   0.000711446 0.0002279987        3.120        0.0018  LENGTH OF STAY
LOSSQRD      1 -0.000006634  .00000305233       -2.173        0.0298
NHBPOP       1 .00000470655  .00000191608        2.456        0.0140  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1   0.005677811   0.003263812        1.740        0.0819
PHYSPOP      1 -.0000030362  .00000842324       -0.360        0.7185  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   0.004771388   0.002469001        1.933        0.0533
SPMDPCT      1 .00003189765  .00004396938        0.725        0.4682  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.004316906   0.001782511        2.422        0.0155
TCH2_DUM     1 -.0000878977   0.001952037       -0.045        0.9641
TCH3_DUM     1   0.003018992   0.003699623        0.816        0.4145
TEFRA        1   0.003163878   0.001968185        1.608        0.1080
PPS_DUM      1    0.00442986   0.002058331        2.152        0.0314
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Hernia Complication - 14 Day
PPS Trend

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                                                                        16:17 WEDNESDAY, OCTOBER 5, 1988     5

DEP VARIABLE: RE_14_YN

                       SUM OF         MEAN
SOURCE      DF        SQUARES       SQUARE        F VALUE       PROB>F

MODEL       27       0.439568     0.016280          2.502       0.0001
ERROR    26037        169.439  0.006507608
C TOTAL26064          169.878

   ROOT MSE          0.080670     R-SQUARE         0.0026
   DEP MEAN       0.006560522     ADJ R-SQ         0.0016
   C.V.              1229.624

                    PARAMETER       STANDARD    T FOR HO:                      VARIABLE
VARIABLE    DF       ESTIMATE          ERROR  PARAMETER=0    PROB > |T|          LABEL

INTERCEP     1      -0.010850       0.013263       -0.818        0.4133   INTERCEPT
AGE          1  .00006875825  .00007661272          0.897        0.3695   BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1    -0.00371265    0.002550643       -1.456        0.1455
BED_DUM1     1    -0.00117823    0.003089207       -0.381        0.7029
BED_DUM2     1    -0.00190632    0.002300756       -0.829        0.4074
BED_DUM3     1    -0.00229536     0.00179164       -1.281        0.2002
BED_DUM4     1    -0.00203384    0.001601299       -1.270        0.2041
BED_DUM5     1   -0.000770327     0.00162645       -0.474        0.6358
CAPINC       1  .00009758415   0.0001157032         0.843        0.3990   MEAN PER CAPITA INCOME (TEBI)
EDUC         1    0.001007902    0.001008044        1.000        0.3174   MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1    -0.00190089    0.001600417       -1.188        0.2349
GOV_DUM      1    0.002202286    0.001544812        1.426        0.1540
HMOPOP       1  -.0000010788  .00007278257         -0.015        0.9882   % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1    -0.00359742    0.004641359       -0.775        0.4383
HOS_RUR      1   0.0003892284    0.001589038        0.245        0.8065
ICCU_YN      1    -0.00112395    0.002670796       -0.421        0.6739
LOS          1   0.0002419286   0.0001540195        1.571        0.1162   LENGTH OF STAY
LOSSQRD      1  -.0000025979  .00000206842         -1.256        0.2091
NHBPOP       1  .00000356433  .00000130094          2.740        0.0062   NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1    0.005607069    0.002215152        2.531        0.0114
PHYSPOP      1   -1.39289E-07   0.0000057188       -0.024        0.9806   PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1    0.002541454     0.00167678        1.516        0.1296
SPMDPCT      1  .00000912107  .00002985633          0.305        0.7600   % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1    0.006011877    0.001193197        5.038        0.0001
TCH2_DUM     1    -0.00115719    0.001325068       -0.873        0.3825
TCH3_DUM     1    0.001627901    0.002510965        0.648        0.5168
TEFRA        1   0.0003478824    0.001226428        0.284        0.7767
TREND1       1   0.0002055791   0.0006585093        0.312        0.7549
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Hernia Complication - 30 Day
PPS Trend

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                                                                                 16:17 WEDNESDAY, OCTOBER 5, 1988    6

DEP VARIABLE: RE_30_YN

                   SUM OF         MEAN
SOURCE     DF     SQUARES       SQUARE      F VALUE      PROB>F

MODEL      27    0.582339     0.021568        2.273      0.0002
ERROR   26037     247.020  0.009487261
C TOTAL26064      247.602

    ROOT MSE     0.097403     R-SQUARE       0.0024
    DEP MEAN  0.009591406     ADJ R-SQ       0.0013
    C.V.         1015.519


                PARAMETER     STANDARD    T FOR HO:                     VARIABLE
VARIABLE   DF    ESTIMATE        ERROR  PARAMETER=0   PROB > |T|          LABEL

INTERCEP    1   -0.023287     0.016014       -1.454       0.1459  INTERCEPT
AGE         1 .00008184491 .00009250402       0.885       0.3763  BENEFICIARY AGE AS OF ADMISSION DATE
AGED        1  -0.00601737  0.003079707      -1.954       0.0507
BED_DUM1    1  -0.00279481  0.003729982      -0.749       0.4537
BED_DUM2    1  0.002122639  0.002777987       0.764       0.4448
BED_DUM3    1 -0.000624679  0.002163269      -0.289       0.7728
BED_DUM4    1 -0.000524207  0.001933447      -0.271       0.7863
BED_DUM5    1 -0.000871362  0.001963814      -0.444       0.6573
CAPINC      1 0.0001095476 0.0001397029       0.784       0.4330  MEAN PER CAPITA INCOME (TEBI)
EDUC        1  0.001901222  0.001217136       1.562       0.1183  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE      1  -0.00344594  0.001932382      -1.783       0.0746
GOV_DUM     1  0.002709252  0.001865242       1.452       0.1464
HMOPOP      1 .00007412759 .00008787941       0.844       0.3989  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC      1 0.0009291217  0.005604088       0.166       0.8683
HOS_RUR     1    0.0022587  0.001918642       1.177       0.2391
ICCU_YN     1  -0.00116807  0.003224782      -0.362       0.7172
LOS         1 0.0004079117 0.0001859668       2.193       0.0283  LENGTH OF STAY
LOSSQRD     1 -.0000043741 .00000249746      -1.751       0.0799
NHBPOP      1 .00000293295 .00000157078       1.867       0.0619  NURSING HOME BEDS PER 100K POPULATION
NONWHITE    1  0.003973136  0.002674627       1.485       0.1374
PHYSPOP     1 -.0000012691 .00000690502      -0.184       0.8542  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM    1  0.003337683  0.002024585       1.649       0.0992
SPMDPCT     1 .00001293449 .00003604925       0.359       0.7197  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN     1  0.005393174  0.001440694       3.743       0.0002
TCH2_DUM    1  -0.00084233  0.001599918      -0.526       0.5986
TCH3_DUM    1  0.005482292  0.003031799       1.808       0.0706
TEFRA       1 0.0003307221   0.00148081       0.223       0.8233
TREND1      1 0.0008139647 0.0007950998       1.024       0.3060
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Hernia Complication - 60 Day
PPS Trend

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                                                            16:17 WEDNESDAY, OCTOBER 5, 1988     7

DEP VARIABLE: RE_60_YN

                      SUM OF         MEAN
SOURCE      DF       SQUARES       SQUARE       F VALUE        PROB>F

MODEL       27      0.967511     0.035834         2.538        0.0001
ERROR    26037       367.666     0.014121
C TOTAL26064         368.634

     ROOT MSE       0.118831     R-SQUARE        0.0026
     DEP MEAN       0.014349     ADJ R-SQ        0.0016
     C.V.           828.1661

                   PARAMETER      STANDARD    T FOR HO:                         VARIABLE
VARIABLE    DF      ESTIMATE         ERROR  PARAMETER=0    PROB > |T|           LABEL

INTERCEP     1     -0.021882      0.019537       -1.120        0.2627  INTERCEPT
AGE          1 .00007172566 0.0001128552        0.636        0.5251  BENEFICIARY AGE AS OF ADMISSION DATE
AGED         1     -0.013504   0.003757252       -3.594        0.0003
BED_DUM1     1   0.002411444   0.004550589        0.530        0.5962
BED_DUM2     1   0.001448791   0.003389153        0.427        0.6690
BED_DUM3     1 0.0004480238   0.002639194        0.170        0.8652
BED_DUM4     1 0.0009078841   0.002358811        0.385        0.7003
BED_DUM5     1 0.0008709872   0.002395859        0.364        0.7162
CAPINC       1 0.0001087087 0.0001704379        0.638        0.5236  MEAN PER CAPITA INCOME (TEBI)
EDUC         1   0.001855549    0.00148491        1.250        0.2115  MEDIAN SCHOOL COMPLETED IN 1970
FEMALE       1    -0.0048655   0.002357512       -2.064        0.0390
GOV_DUM      1   0.005125675   0.002275601        2.252        0.0243
HMOPOP       1 .00006940381 0.0001072131        0.647        0.5174  % OF POP ENR IN HMO (SMSA OR COUNTY)
HOSOCC       1   0.008910131   0.006837003        1.303        0.1925
HOS_RUR      1   0.002415028   0.002340749        1.032        0.3022
ICCU_YN      1   -0.00441657   0.003934244       -1.123        0.2616
LOS          1 0.0006809178    0.00022688        3.001        0.0027  LENGTH OF STAY
LOSSORD      1 -.0000063842 .00000304691       -2.095        0.0362
NHBPOP       1 .00000470458 .00000191636        2.455        0.0141  NURSING HOME BEDS PER 100K POPULATION
NONWHITE     1   0.005796119   0.003263053        1.776        0.0757
PHYSPOP      1   -0.00000292 .00000842415       -0.347        0.7289  PATIENT CARE DRS. PER 100K POPULATION
PROF_DUM     1   0.004637367   0.002469999        1.877        0.0605
SPMDPCT      1 .00003176124 .00004398019        0.722        0.4702  % OF PAT. CARE DRS. WHO ARE SPECIALISTS
SURG_YN      1   0.004720005   0.001757651        2.685        0.0072
TCH2_DUM     1 -.0000503446   0.001951905       -0.026        0.9794
TCH3_DUM     1   0.003144274   0.003698804        0.850        0.3953
TEFRA        1   0.002088018   0.001806603        1.156        0.2478
TREND1       1   0.001633375 0.0009700241        1.684        0.0922
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SELECTING TRACERS

RISK ADJUSTED MORTALITY

PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--
PPS IMPACT ON MORTALITY RATES:
ADJUSTMENTS FOR CASE-MIX SEVERITY

FINAL REPORT

by

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PPS IMPACT ON MORTALITY RATES:
ADJUSTMENTS FOR CASE-MIX SEVERITY

I. INTRODUCTION

Since the initial implementation of Medicare's Prospective Payment System (PPS), there has been considerable public concern over the impact of PPS on the quality of care provided to beneficiaries. Given the financial incentives faced by hospitals under PPS to minimize costs, the concern is that patients may receive fewer and less timely services, and may be discharged prior to full recovery from illness, possibly leading to adverse treatment outcomes or greater future dependence on health care services. It is important that the impact of PPS on the quality of hospital care be assessed and documented, so that necessary changes in policy can be made in a timely fashion.

Quality of care is, however, a difficult concept to operationalize and measure. In theory, the quality of care is best assessed through an analysis of the clinical outcomes of hospital care. Such analyses generally require extensive clinical reviews of medical records or follow-up studies of post-acute care, and require that standards be established to define desirable clinical outcomes. The required level of effort is significant and there is a general lack of established criteria for defining outcomes. A few simple measures of hospital outcomes are available, however, which, while lacking patient level sensitivity, may be useful as indicators of the average quality of care across patients.

One such aggregate measure of hospital outcomes is the mortality rate. The mortality rate is a commonly used indicator of quality because it is objective, easy to measure, and easily understood. It is intuitively appealing in that it seems logical that better quality of care should lead to lower mortality while poorer quality of care should lead to higher mortality. Over a large population, significant increases in mortality rates may indicate that quality of care has declined. Thus by comparing hospital mortality rates before and after PPS, inferences might be made regarding PPS impact on the quality of care. For instance, a higher post-PPS mortality rate might indicate that the quality of care has deteriorated since implementation of PPS.

There are, however, some obvious questions regarding the validity of mortality rates as indicators of the quality of hospital care. Before an analysis of changes in post-PPS mortality rates can be conducted to assess PPS impact, then, a few of the key issues in evaluating mortality rates should be examined.

II. ISSUES IN EVALUATING MORTALITY RATES

There are three basic concerns regarding the interpretation of mortality rates as indicators of changes in the quality of hospital care:

- How accurate are mortality rates as measures of change in hospital quality of care under PPS?
- How should non-hospital factors that affect the risk of mortality be accounted for?
- How should mortality rates be best computed?

These issues and their effects on the study of PPS impact are discussed briefly below.

A. Does mortality indicate poor quality?

Death is without doubt the most extreme adverse outcome that can be related to the provision of health care. To the extent that changes in mortality rates can be attributed directly to changes in clinical treatment practices, quality of care problems are clearly indicated. In more common instances where such direct attributions cannot be easily made, however, the sensitivity and validity of mortality rates as measures of hospital quality of care may be questioned.

With regard to sensitivity, it is important to recognize that the absence of a measureable change in mortality does not necessarily mean that there has been no change in the quality of care. Poor quality of care could result in increased disability, discomfort, illness, or hardship without having a measurable effect on mortality. Mortality rates, then, should be considered an extreme and insensitive measure of quality of care. If increases in mortality rates appear to be solely related to the introduction of a new program such as PPS, for instance, then this is likely to indicate the existence of severe quality of care problems. On the other hand, the absence of changes in mortality rates does not necessarily mean that quality has not changed.

The accuracy and validity of mortality rates as indicators of hospital quality of care can also be questioned. There are many factors which impact on mortality that are unrelated to the effectiveness or quality of medical care. Mortality rates are impacted by changes in incidence and prevalence rates, general standards of living, personal health practices, and public health measures. These and other non-hospital factors may affect a patient's risk of death.

In evaluating the impact of PPS, perhaps one of the biggest concerns in attributing mortality rates to hospital quality of care is the effect that changes in hospitalization patterns and case-mix severity have on hospital mortality rates. Under PPS, there has been an increasing trend for less severely ill patients who are at low risk of morbidity or mortality to be treated in ambulatory rather than inpatient settings. This has resulted in a reduction in the number of Medicare hospital admissions and a greater inpatient concentration of severely ill patients at risk of death. Such trends can cause significant increases in crude mortality rates (total hospital deaths divided by total hospital admissions) even in the absence of any changes in quality of care. A reduction in low-severity patients is not likely to reduce the number of inpatient deaths (the numerator of the mortality rate) but will reduce the total number of hospital admissions (the denominator). The net effect is an increase in the size of the mortality rate even though no increase in number of deaths has occurred. It is important, therefore, that adjustments be made to account for changes in prior risk of mortality before any inferences regarding hospital quality of care can be based on observed changes in mortality rates.

B. Adjusting for prior risk of mortality

A number of methods have been employed to adjust for prior risk when analyzing hospital outcomes. Blumberg (1986) has provided a comprehensive review of methodologies used to conduct Risk-Adjusted Monitoring of Outcomes. The most widely used method in such "RAMO" studies involves patient classification and indirect standardization. Patients are first classified into risk-homogeneous categories based on their characteristics at time of hospital admission. Outcome rates (e.g., mortality rates) by patient category are then calculated based on a referent or base-group. These rates are applied to the study group by patient category, and are averaged across all study patients to estimate the expected outcome rate of the study group. This expected outcome rate thus accounts for patterns of differential risk at time of hospital admission. Differences between the expected and observed outcome rates can as a result be more accurately attributed to hospital quality of care. Analyses can identify patient or provider group with outcomes that are better or worse than expected, and can identify various factors (e.g., treatment regimen, medical technology, hospital reimbursement) that impact on the difference between observed and expected outcomes.

One of the most comprehensive risk-adjusted analyses of hospital outcomes was Stanford's 1974 "Study of Institutional Differences in Post-Operative Mortality." This study used computerized discharge abstract data to indirectly standardize post-surgical mortality rates in 1224 hospitals based on patient, diagnosis and procedure risk variables, and attempted to relate differences in mortality to institutional characteristics. The study's results showed that adjusted mortality rates are correlated with hospital characteristics (e.g., type of control, size, occupancy rate, teaching status, urban/rural location) and depend upon the specific type of surgery.

A growing number of studies have used risk-adjustment methods to evaluate the relationship between hospital mortality rates and the volume of high-risk surgeries. Most of these studies have focused on specific surgical procedures such as coronary artery bypass graft, total hip replacement, catheterization, and prostatectomy (Farber, et al. 1981, Luft, et al. 1979; Luft, 1980; Luft & Hunt, 1986; Wennberg, 1986) or on specific medical diagnoses such as acute myocardial infarction, peptic ulcer disease, subarachnoid hemorrhage, and burns (Flood, et al. 1984; Maerki, et al. 1986; Shortell and LoGerfo, 1981; Wolfe, et al. 1983). These studies differ in data, sample, and focus but share one aspect of methodology. All analyses of mortality rates are adjusted for differential mortality risk by classifying patients on such characteristics as age, sex, morbidity, and urgency of admission. The study's results indicate a significant inverse relationship between patient/surgical volume and adjusted mortality rates.

The majority of these studies have used simple classifications of patient age and disease to adjust for differential risk factors in analyzing mortality rates. More sophisticated classification systems exist, however, and should be assessed for their applicability in such analyses. One such system is the Diagnosis Related Groups (DRG) system used for hospital payment under PPS.

The DRG system has three major limitations for use in this context. First, DRG classifications of patients have been defined to be homogeneous in terms of resource consumption, not risk of adverse outcomes. Therefore, they are not necessarily homogeneous in terms of mortality rates. Second, many of the patient classifications are largely insensitive to variations in disease severity, a natural correlate of the mortality rate. As a result, significant variation in mortality rates can be found in many DRGs. Third, many of the DRG classifications are defined by the nature of surgical procedures that are provided during the inpatient treatment process. Since the choice of procedure may itself affect the quality of care, it would be inappropriate to use such classifications for case-mix adjustments of mortality rates.

C. Computation of mortality rates

While the concept of the simple mortality rate is seemingly intuitive, the actual definition depends on the choice of referent population and the choice of point in time at which to measure mortality. The actual definition of mortality rate is a critical factor in the evaluation of PPS impact on quality of care.

Three types of mortality measures can be defined:

- Population mortality
- Discharge mortality
- Post-Admission mortality

Population mortality is a simple measure of total deaths, without regard to place of death or hospitalization experience, and is generally expressed as deaths per 100,000 population. The advantage of this measure for assessing PPS impact is that it is based on the total population at risk (e.g., Medicare beneficiaries) and is not affected by changes in hospital admission patterns and utilization rates. However, it has the strong disadvantage of including mortality that is unrelated to the provision of health care. This disadvantage limits its use in the evaluation of PPS impact on hospital quality of care.

Discharge mortality is a simple measure of the percent of hospital admissions in which the patient is discharged dead. While the discharge mortality rate is widely used in research on hospital outcomes and intuitively appears to be a good measure of the quality of care delivered during hospitalization, it is characterized by a serious validity problem. Because the period of observation (from admission to discharge) is defined by the length of hospital stay, factors that impact on the length of stay but that are unrelated to hospital quality of care may have direct impact on the discharge mortality rate. For instance, if post acute-care nursing and home health care services are unavailable, chronically-ill patients may be retained in the hospital until they either recuperate or die. Regions of the U.S. that differ in length of stay due to differential availability of post acute-care services are thus likely to exhibit different discharge mortality rates even if they provide the same quality of care to the same mix of patients. The fundamental difference between the two regions would be the location of the patient at time of death (in-hospital vs. out-of-hospital). Discharge mortality rates are thus too sensitive to differential length of stay patterns to provide a valid indication of quality of care, especially when assessed over a large area in which local variation in length of stay is exhibited.

Post-admission mortality rates are preferable to discharge mortality measures in that they are defined on the basis of a fixed time interval from admission. This approach avoids biases due to regional patterns of length of stay and possible constraints on the placement of patients to alternative settings due to variations in the availability of skilled nursing facilities, intermediate care facilities, or home health care services.

The choice of time interval following admission has direct bearing on the validity of post-admission mortality as a measure of hospital quality. An interval that is too short will lack sensitivity to the typical quality of care problems that do not result in immediate death but that may increase the patient's risk of morbidity, prolong hospitalization, and eventually result in death. An interval that is too long, on the other hand, may include deaths that resulted from causes unrelated to the hospitalization and may therefore overstate the mortality rate in an unknown and inconsistent fashion. An interval of 30 days from admission defines a good compromise between these two concerns and is still generally unaffected by variations in hospital length of stay.

III. PURPOSE OF THE STUDY

The purpose of this study was to evaluate the impact of PPS on hospital quality of care by assessing changes in mortality rates between fiscal years 1984 and 1985, while adjusting for differential case-mix severity in the two years. The study thus had two objectives. The first was to develop a patient classification system in which patient categories are homogeneous on risk of mortality. The second was to use this system to adjust and compare mortality rates in 1984 and 1985 so as to evaluate the impact of PPS.

Mortality was defined based on a fixed 30-day interval from admission. Disease severity was defined with the Disease Staging methodology and was used to form a patient classification system based on mortality risk. Severity of principal disease, number of high-risk comorbidities, age, and sex formed the basis of the patient classifications. Methods of indirect standardization were used to derive a 1985 expected overall mortality rate based on 1984 mortality rates per severity level. Comparisons were then made between the expected (severity adjusted) mortality rate and the observed mortality rate for 1985 as an assessment of PPS impact.

The remaining sections of this report present the study in detail. Section IV descibes the study's methodology including a discussion of the data, variables, and analytic approach. Section V presents the results of the analyses. Section VI concludes the report with a discussion of implications of the findings, limitations of the study, and recommendations for future research.

IV. METHODOLOGY

This section describes the data and methodology used in this study. Part A describes the 1984 and 1985 data files. Part B defines the variables that were created for the analysis. Part C presents the analytical approach taken to form mortality-risk homogeneous classifications and to conduct risk-adjusted comparisons of 1984 and 1985 mortality rates.

A. Data Files

Analyses were conducted on data from the 20 percent MEDPAR files for fiscal years 1984 and 1985. Each file consisted of a random 20 percent sample of Medicare inpatient discharge records. Each record contained the standard UHDDS data elements including age, sex, diagnoses (up to 5), procedures, discharge status, and other hospital, patient and clinical characteristics.

In addition to the discharge status for in-hospital deaths, the file contained the date of death (merged onto the records by HCFA from Social Security entitlement files) for all beneficiaries who died during 1984, 1985, and 1986 regardless of location of death.

Table 1 presents the size of the original data files and the size of the data files after data exclusions. The FY 1984 and FY 1985 20 percent MEDPAR files contained 2,226,665 and 1,977,040 discharge records. Table 1 also shows the types of exclusions made in the formation of analysis files. These exclusions reduced the sample by less than 0.03 percent in each year.

TABLE 1
Discharge Record Exclusion

	FY 1984	FY 1985
Records Before Exclusions	2,226,665	1,977,040
Invalid or missing ICD-9-CM Code	192	36
Wrong date of discharge	0	144
Date of death earlier than date discharged alive	227	288
Total Records Excluded	419	468
Records after exclusions	2,226,246	1,976,572

B. Variables

This section describes the four types of variables that were crucial to the analyses:

- 30-day post admission mortality
- Age
- Sex
- Disease severity

1. 30-Day Post-Admission Mortality

For this study, only deaths within 30 days of a hospital admission were included in the calculation and analysis of mortality rates. As discussed above, It is preferable to count deaths during a fixed interval following admission rather than during a variable observation period inherent in discharge mortality and fixed-interval post-discharge mortality because it controls for the bias that could be introduced by regional variations in lengths of stay. The interval of 30 days was chosen because it is large enough to cover most lengths of stay yet small enough to reasonably link cause of death to cause of hospitalization (a 60-day interval would better control for variable lengths of stay, but the relationship between cause of hospitalization and cause of death would be more tenuous.)

Central to the definition of 30-day post-admission mortality is the accurate determination of date of death. Table 2 presents a breakdown of mortality and date of death. The percentage of discharges with record of death in FY 1984 and FY 1985 was 18.7 percent and 20.1 percent, respectively.

TABLE 2
Mortality and Date of Death

	FY 1984 Discharges		FY 1985 Discharges	
	N	%	N	%
Total for Analysis	2,226,246	100.0	1,976,572	100.0
No Record of Death During FY (a)	1,808,945	81.3	1,579,169	79.9
Record of Death During FY (b)	417,301	18.7	397,403	20.1
Discharged Dead (last stay)	123,731	5.6	120,364	6.1
Death Date = Discharge Date	120,382		116,788	
Death Date After Discharge Date (c)	2,674		2,908	
Death Date Before Discharge Date (c)	360		331	
Death Date Missing (c)	315		337	
Discharged Alive (all stays)	293,570		277,039	
Death Date = Discharge Date (d)	11,499		5,796	
Death Date After Discharge Date	282,071		271,311	
Total Number of Admissions with Death Within 30 Days	169,624		165,224	

a) Record of death may be up to one month past the end of the fiscal year.

b) Discharge records of patients that were discharged alive after the recorded date of death are excluded (FY 1984 N = 227, FY 1985 N = 288)

c) For analysis purposes, Death Date is assigned the value of Discharge Date.

d) Assume discharged dead.

For a number of cases discharged dead, the date of death from entitlement files conflicts with the date of discharge. If the dates disagreed and a patient had a record of death and was discharged dead then the date of death was assumed to be the discharge date. If a patient had a record of death but was discharged alive on the date of death, then it was assumed that the discharge status on the record was incorrect and that the patient was discharged dead.

Table 3 gives a breakdown of the discharges associated with patients who had dates of death between 1984 and 1986. It shows the percentage of death discharges by days from admission to death and the percentage of live discharges from admission to death. For patients discharged dead, the number of days from admission to death is essentially the length of stay (LOS) for the final discharge record. Thus, for patients who were discharged dead, about 90 percent had a LOS of 30 days or less. For patients discharged alive but who had a later record of death only about 20 percent died withing 30 days of a hospital admission.

TABLE 3

Percentage of Discharges for Patients Who Died by Days from Admission to Death and By Discharge Status

Days From Admission to Death	FY 1984 Discharge Status			FY 1985 Discharge Status		
	Dead (n=123,731)	Alive (n=293,570)	All (n=417,301)	Dead (n=120,364)	Alive (n=277,039)	All (n=397,403)
0 - 30	90.3	19.7	40.6	92.2	19.6	41.6
31 - 60	7.5	21.0	17.0	6.1	21.4	16.7
over 60	2.2	59.0	42.4	1.7	59.1	41.7
All	100.0	100.0	100.0	100.0	100.0	100.0

Table 4 shows a breakdown of the number of admissions for patients during each fiscal year. The number of patients in FY 1984 and FY 1985 was 1,401,696 and 1,266,757. Each year, two-thirds of the patients had only one admission during the fiscal year. The average number of admissions per patient was virtually the same in FY 1984 as in FY 1985 (1.89 vs. 1.84).

TABLE 4

Number of Admissions per Patient

Number of Admissions	FY 1984 Patients		FY 1985 Patients	
	N	%	N	%
1	920,217	65.7	846,276	66.7
2	294,548	21.0	260,576	20.6
3	107,537	7.7	92,983	7.3
4	42,987	3.1	36,579	2.9
5 - 32	36,407	2.5	30,343	2.5
Total Patients	1,401,696	100.0	1,266,757	100.0

In this study, the count of mortality was restricted to patients who died within 30 days of at least one admission. This group of patients represents 10.5 percent of all FY 1984 patients (6.6 percent of admissions) and 11.3 percent of all FY 1985 patients (7.2 percent of admissions). This group of patients also represents about two-thirds of all patients who died during each year. The other one-third of patients died over 30 days later than any hospital admission recorded in the file or (a small percentage) died in the hospital after a stay of over 30 days.

Table 5 presents the distribution of the number of admissions occurring within 30 days of death. Approximately 15 percent of the time, the death occurred within 30 days of more than one hospital admission.

Since the mortality rate in this study was defined as the ratio of deaths to admissions, and since the aim of this study was to identify clinical and demographic characteristics correlated with 30-day post-admission mortality, it was necessary to match each death with a single hospital admission. For the 15 percent of cases with multiple admissions within 30 days of death, the admission just prior to death was considered most likely to be related in terms of etiology. To identify a single admission to obtain comorbidity information, the first admission during the 30 days that had the same type and severity of principal diagnosis as the admission just prior to death was associated with the death.

TABLE 5

Number of Admissions Within 30 Days of Death for Patients Who Died Within 30 Days of Admission

Admissions Within 30 Days of Death	FY 1984 Patients		FY 1985 Patients	
	N	%	N	%
1	126,729	86.1	122,418	85.7
2	18,704	12.7	18,520	13.0
3	1,610	1.1	1,706	1.2
4 - 6	146	0.1	144	0.1
Total	147,189	100.0	142,788	100.0

For analysis purposes, all other admissions within the 30 days of death were not associated with the death. The final number of admissions associated with death within 30 days was thus equal to the number of patients that died within 30 days of at least one admission.

2. Age

Age is a strong correlate of the probability of death and was therefore considered an important variable in the analysis. Since the study was restricted to the Medicare population, most of the cases (94 percent) were at or above age 65.

For the purposes of analysis, three groups were defined:

- less than 70 years of age
- 70 to 79 years of age
- 80 years of age and older

These three groups accounted for 30 percent, 45 percent and 25 percent of the admissions in the combined analysis files, respectively.

3. Sex

Given overall difference in mortality rates between the two sexes, especially in the Medicare population (males having higher probability of death at any specific age than females), sex was also considered an important variable in the analysis. In the combined analysis files 45 percent of the cases were male, and 55 percent were female. The percentage of males declined with increasing age, due to the higher male mortality rate.

4. Disease Severity

The assessment of each patient's severity of illness involved the determination of severity for each of a patient's diseases and medical problems. For analysis purposes, a distinction was made between the severity of the principal disease and the extent of high-risk unrelated comorbidities.

The severity of each disease was determined using the Disease Staging methodology. A description of this methodology and its use in defining the severity of principal and comorbid diseases is provided below.

a. Disease Staging

Disease Staging is a clinically-based measure of severity that uses objective medical criteria to assess severity based on the etiology and stage of disease progression. Staging defines discrete points in the course of individual diseases that reflect severity in terms of risk of death or residual impairment, and possess clinical significance for prognosis and choice of therapeutic modality.

Medical staging criteria have been developed for approximately 400 diseases. These criteria have been translated into recognized international disease classification rubrics so that Disease Staging criteria can be applied either to medical records or to computerized hospital discharge abstract data. Automated Staging operates on the same standard UB82 data elements as the DRG Grouper does. Every diagnostic code on a patient's medical record is used to determine a disease category and stage.

i. Disease Stages

As a disease advances, it naturally progresses through four general stages of increasing complexity and system involvement:

Stage 1:	Conditions with no complications or problems of minimal severity.
Stage 2:	Problems limited to an organ or system; significantly increased risk of complications.
Stage 3:	Multiple site involvement; generalized system involvement; poor prognosis.
Stage 4:	Death

In Disease Staging, clinical criteria have been determined for each disease to define progressive stages modeled on the above framework. Substages have been defined within Stages I, II, and III to further specify levels of disease progression. Each stage and substage is defined on the basis of objective clinical findings and standard diagnostic nomenclature.

An example of the clinical staging criteria for appendicitis is presented below:

Stage	Description
1.0	Appendicitis
2.1	Appendicitis with Perforation Causing: Localized peritonitis Peritoneal abscess
2.2	Appendicitis with Perforation Causing: General peritonitis
2.3	Intestinal Obstruction
2.4	Pyelphlebitis With or Without Liver Abscess
3.1	Septicemia
3.2	Shock
4.0	Death

In terms of its natural progression, appendicitis begins without complications. If it is not treated in time it can perforate, causing localized peritonitis or peritoneal abscess and later generalized peritonitis. Without effective treatment this can eventually lead to septicemia. Ultimately the patient may go into shock and die. Other complications or comorbidities may occur leading to death.

It is important to recognize that not all patients experience every stage before death, and that the principal disease is not necessarily the cause of death for patients that die. However, patients at higher stages of the principal disease are generally at higher risk of death than patients at lower stages of the same disease.

Every diagnostic code on the patient's record is assigned a disease category and is staged. For example, if an individual has both appendicitis and diabetes mellitus, the presence and stages of both of these diseases will be identified by the staging software.

ii. Disease Stages for Patients that Died

The Disease Staging methodology was adjusted to identify the stage of disease attained just prior to death by each deceased patient. In its standard form, Staging returns a stage of 4.0 for any disease qualifying as the cause of death (through evidence of sufficient disease severity and discharge status of death). By adjusting the discharge status indicator, Staging can be modified to return the highest stage of a disease attained by a deceased patient prior to death. The actual cause of death may be a secondary or unrelated problem rather than the principal disease. Thus, if a patient was admitted for urinary tract infection (UTI) but died of pneumonia during hospitalization, the principal disease of UTI may be at a low stage but the comorbidity of pneumonia would be at a high stage prior to death.

Staging does assign substages within stages 1, 2, and 3 to designate finer levels of disease progression. However, the small numbers of cases at each substage precluded their use in these analyses. The study therefore focused on integer stages (1, 2, 3) for characterizing the severity of each disease. The integer stages do, after all, define the generic levels of disease progression that underlie the Staging system. The integer stages are clinically differentiated in terms of the spread of a disease, and in terms of a patient's risk of morbidity and mortality.

b. Principal Disease

Disease Staging defines approximately 400 specific disease categories in 15 body systems. The principal disease is the disease category that corresponds to the patient's principal diagnosis. The staging software carefully examines each of the secondary diagnoses and their relationships to the principal disease to determine the most likely underlying cause for the admission. Approximately 15 percent of the time, on average, a secondary diagnosis is determined to be the most likely cause for admission. Eighty-five percent of the time the principal diagnosis is identified by the Staging software as the likely cause for admission. For purposes of this evaluation, the underlying principal disease (identified by the Staging software) was used for clinically classifying patients.

c. High-Risk Unrelated Comorbidities

The identification of complications and comorbidities is an important concern in estimating the risk of death to patients. Generally speaking, patients having greater complications or patients concurrently mainfesting several unrelated problems are likely to be at higher risk of death than patients with single, uncomplicated disease occurrences. According to the current DRG definitions, complications and comorbidities are identified from a list of diseases thought to require an additional day of hospitalization for 75 percent of cases in which they occur as secondary diagnoses. Neither the severity of a secondary diagnosis, nor its relationship to the principal disease is considered in defining complications or comorbidities for DRG assignment.

Disease Staging accounts for related complications in determining the stage of the principal disease, but it does not account for co-occurring secondary diseases that are unrelated to the principal disease. Given the significant role that unrelated secondary diseases play in determining the probability of mortality for any given patient, it was necessary to develop an operational definition of "unrelated comorbidities."

The Disease Staging methodology is especially well suited for defining unrelated comorbidities since its determination of disease severity involves the identification of related complications for each of a patient's diseases. For a given disease, the clinical staging criteria define the particular secondary diagnosis codes that represent complications (and higher stages) of that disease. These complications are thus directly related to that disease and are redundant with the stage of that disease. They should therefore be excluded from the analysis of unrelated comorbidities.

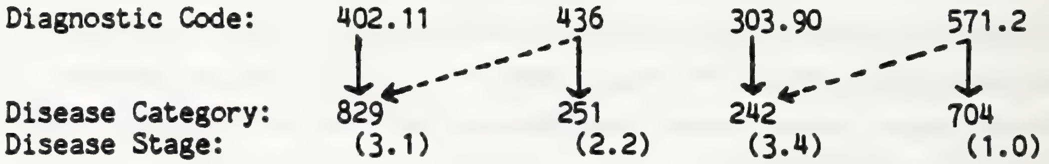
To identify unrelated comorbidities, then, it is necessary to first identify related complications. In this study, any two of a patient's diseases were defined as related to each other if the diagnosis code defining one of the diseases represented a step in the progression of the other disease (as defined in the staging criteria for that disease). By implementing this definition, a patient's diagnosis codes that represent complications of one of his/her diseases (thus increasing the stage value of that disease) could be identified and excluded from further consideration. This process thus isolated the mutually unrelated diseases per patient for further analysis.

Table 6 presents a simple example to clarify this definition of unrelated comorbidity. In the example, a patient has four diagnostic codes. Each code is classified by Disease Staging into a disease category (here signified by a solid line). A code may also represent a step in the progression of another disease (signified by a broken line) whose category is defined by one of the other diagnosis codes. In the example, the code 436, representing Cerebrovascular Disease also represents a stage (3.1) in the progression of Essential Hypertension. Thus, these two diseases are related, as are Alcoholism and Cirrhosis of the Liver. Since Cerebrovascular Disease and Cirrhosis of the Liver represent complications

TABLE 6

Example of Definition of Unrelated Comorbidity

Assume a patient has the following diagnostic codes.



Unrelated Comorbidity Algorithim Yields:

Principal Disease: 829 Essential Hypertension, Stage 3.1

Unrelated Comorbidity: 242: Alcoholism, Stage 3.4

Diagnostic Codes	Staging Disease Categories
402.11 (Hypertensive Heart Disease with CHF)	829 (Essential Hypertension)
436 (Cerebrovascular Accident)	251 (Cerebrovascular Disease)
303.90 (Chronic Alcoholism)	242 (Alcoholism)
571.2 (Alcoholic Cirrhosis of Liver)	704 (Cirrhosis of the Liver)

manifested in the progression of Essential Hypertension and Alcoholism, they are eliminated from consideration as unrelated comorbidities by the comorbidity algorithm. In the mortality analyses, Essential Hypertension (at stage 3.1) would be considered the principal disease and Alcoholism (at stage 3.4) would be an unrelated comorbidity.

A computer algorithm was developed to implement this definition so that from any set of diagnostic codes one could derive the mutually unrelated diseases (and their severity levels) characterizing a given patient. Thus, empirical analyses focused on the severity of principal diseases and unrelated comorbidities as defined by the algorithm.

A special effort was made in this study to distinguish comorbidities likely to pre-exist at time of admission from problems likely to have arisen during the hospital stay. Problems that arise during hospitalization may indicate deficits in the quality of care, and should not be included in this effort as part of a severity adjustment.

To identify likely pre-existing comorbidities a small panel of experts was formed. The panel was asked to identify, from the Disease Staging classification system, all diseases which, when appearing as secondary diagnoses, were likely to indicate problems that pre-existed prior to hospitalization in 75 percent of cases. Diseases that were not so identified, and that could have arisen during hospitalization were eliminated from the analysis of comorbidities. Only those secondary diagnoses that were likely to indicate pre-existing problems were analyzed as comorbidities in this study.

To define mortality risk levels for the diseases appearing as comorbidities, mortality rates were examined for each stage of each principal disease. A stage of a comorbidity was considered to be "high risk" if the crude mortality rate of the same stage and disease as a principal disease was (statistically) significantly greater than 10 percent in FY 1984.

As an example, consider the stage specific mortality rates below for cases with one of two principal diagnoses, Essential Hypertension or Diabetes Mellitus.

1984 Medicare 30-day Post-Admission
Mortality Rates by Stage of Disease

	Mortality Rates (percent)	
Stage	Essential Hypertension	Diabetes Mellitus
1	1.26	1.97
2	4.95	2.57
3	8.28	14.35
All	6.05	4.59

According to the algorithm for defining high-risk comorbidities, cases with an unrelated comorbidity of Essential Hypertension would not be designated as "high risk" of mortality at any stage of the disease. A comorbidity of Stage 3 Diabetes Mellitus, on the other hand, would be considered at high risk of mortality (since its mortality rate as principal disease, 14.35 percent, significantly exceeds 10 percent).

For analysis purposes, the count of high-risk comorbidities for each patient was used as a measure of the severity of comorbidities. Since fields for five diagnostic codes were available on the data records, and since the first listed code designated the principal diagnosis, a maximum of four high risk comorbidities could be defined for any given patient.

C. Analytic Approach

The primary analytic objective of the study was to compare 1984 and 1985 Medicare inpatient mortality rates after adjusting for changes in case-mix severity. A secondary objective of the study was to develop a severity classification system that could be used in cross-sectional as well as longitudinal analyses of mortality rates. To meet these objectives two separate analytical models were formulated to analyze mortality rates based on age, sex, the type and severity of the principal disease and the extent of high-risk comorbidities. The first model included all interactions (cross-classifications) between the five explanatory variables and was used to severity-adjust mortality rates in a statistical fashion. The second model collapsed variable combinations with similar mortality rates to form a parsimonious mortality risk-homogeneous classification system, which was then used to indirectly standardize the overall 1985 mortality rate based on 1984 within-class mortality rates. These two modeling efforts are described in further detail below.

1. Fully interactive model

As a first step toward a severity-adjusted analysis of the overall 1985 mortality, a fully interactive model was formulated consisting of all interactions between the five variables of:

- Principal disease category (approx. 400),
- Stage of principal disease (1, 2, 3),
- Number of high-risk unrelated comorbidities (0, 1, 2, 3+),
- Age (<70, 70-79, 80+),
- Sex (M/F).

Within each cell of this model, the 1984 mortality rate was calculated and was multiplied by the count of 1985 admissions to obtain an "expected" 1985 mortality count for the cell. This count represented the mortality count for the given cell that would be expected if the mortality rate for the cell stayed constant between 1984 and 1985.

By summing these expected 1985 mortality counts across all cells in the model a total expected 1985 mortality count was estimated. This expected mortality count was then compared to the actual mortality count by forming the Standardized Mortality Ratio (SMR):

$$\text{SMR} = \frac{\text{Observed 1985 Mortality Count}}{\text{Expected 1985 Mortality Count}}$$

$$= \frac{\text{Observed 1985 Mortality Count}}{\sum_{i=1}^{k} (\text{1984 Mortality Rate})_i * (\text{1985 Admissions})_i}$$

where $i = 1, 2, \ldots, k$ indexes the k cells in the full model.

As an example of how case-mix differences can affect comparisons of mortality rates, consider the hypothetical data in the table below.

TABLE 7

		Mortality		Discharges		Mortality Rate	
Age	Sex	FY 84	FY 85	FY 84	FY 85	FY 84	FY 85
age ≤ 69	Male	50	25	1,000	500	.05	.05
	Female	30	15	1,000	500	.03	.03
70 ≤ age ≤ 79	Male	80	80	1,000	1,000	.08	.08
	Female	60	60	1,000	1,000	.06	.06
age ≥ 80	Male	110	165	1,000	1,500	.11	.11
	Female	90	135	1,000	1,500	.09	.09
	Total	420	380	6,000	6,000	.07	.08

The crude mortality ratio is 1.14 (0.8/.07), indicating that the 1985 crude mortality rate is 14 percent higher than the 1984 crude mortality rate in the hypothetical example. Yet, the within-cell mortality rates are identical. The higher 1985 mortality count is explained by the difference in age mix between 1984 and 1985. In the 1985 hypothetical data, there are fewer patients in the low-risk age group and more patients in the high-risk age group than there are in 1984. The expected 1985 mortality count, taking into account the patient mix, is obtained by summing the product of the within-cell 1984 mortality rate and the within-cell 1985 number of discharges. The sum in this case is 480, which is equal to the observed 1985 mortality. Therefore, the age- and sex-adjusted SMR is equal to 1, indicating that the 1985 mortality is just what one would expect based on the 1984 age- and sex-specific mortality rates.

To assess the impact of various levels of severity adjustments in the actual data on the resulting SMR, the model was analyzed for different combinations of variables. Each of the following separate analytical models were analyzed:

TABLE 8

Hierarchical Levels of Interactive Model

Variables in Model	Number of Strata
None (unadjusted)	1
Principal Disease	398
Pr. Dis * Stage of Pr. Dis	992
Pr. Dis * Stage * # High-Risk Comorbidities	2,772
Pr. Dis * Stage * Age	2,803
Pr. Dis * Stage * Sex	1,893
Pr. Dis * Stage * H-R Comorbid * Age	7,119
Pr. Dis * Stage * H-R Comorbid * Age * Sex	12,390

The total number of strata (cells) defined by the final fully interactive model is very large and perhaps excessive for many practical applications of severity-adjustment of mortality rates. However, this model provided the most detailed and thorough analysis possible. By estimating SMRs using each specification of the analytical model, the incremental impact of each of the variables in explaining 1984-1985 changes in mortality rates could be assessed.

2. Risk-homogeneous classification system

The same five stratification variables as those used in the fully interactive model were also used to create the risk-homogeneous classification system. However, the number of high-risk comorbidities was reduced to three categories (0,1,≥2) because of the low frequency of three or more high-risk comorbidities.

The 1984 and 1985 20 percent MEDPAR data were pooled for this analysis because the objective was not so much to explain differences between 1984 and 1985 mortality as it was to test the significance of potential mortality risk factors. In addition, classifications based on only a single year may be characterized by idiosyncracies unique to that year.

Two different classifications were developed, one for "high mortality" and another for "low mortality" disease categories.

a. High Mortality Diseases

Due to their significant impact on the overall mortality rate, the decision was made to develop disease-specific classifications for those principal diseases that accounted for the majority of mortalities. The discussion below describes the selection of high mortality diseases and the various analytical steps used to create risk-homogeneous classifications within each disease.

i. Selection

To identify the diseases with highest mortalities, disease categories were ranked based on 1984 30-day mortality counts (see Table 9). The top 20 listed diseases, accounting for 75 percent of mortalities, were then selected for disease specific classification analyses. This set of 20 diseases has a combined 1984 30-day mortality rate of 9.99 percent (compared with the total 1984 30-day mortality rate of 6.6 percent).

TABLE 9

50 Diseases with Highest Medicare 30-Day Mortality

Rank	DXCAT	Disease Title	Mort. Count FY 84	% of Total 1984 Mortality	Cum %
1	815	Coronary Artery Disease---Acute Myocardial Infarction	22205	15.01	15.01
2	251	Cerebrovascular Disease (Cerebral or Precerebral Arteries)	12983	8.78	23.79
3	504	Bacterial Pneumonia	11231	7.59	31.38
4	890	Other Cardiovascular Conditions	10208	6.90	38.28
5	527	Cancer of the Lung, Bronchus and Mediastinum	7138	4.83	43.11
6	525	Bronchitis and Chronic Obstructive Pulmonary Disease	5618	3.80	46.91
7	590	Other Respiratory Conditions	5331	3.60	50.51
8	821	Arrhythmias and Conduction Disorders	4632	3.13	53.64
9	1698	Metastatic Carcinoma with Unstated Primary	4176	2.83	56.47
10	690	Other Gastrointestinal Conditions	4008	2.71	59.18
11	1290	Other Endocrine and Metabolic Conditions	3908	2.64	61.82
12	902	Acute Renal Failure	3326	2.25	64.07
13	629	Essential Hypertension	2430	1.64	65.71
14	624	Cancer of the Colon and Rectum	2095	1.42	67.13
15	1591	Other Neoplasms	2017	1.36	68.49
16	1214	Diabetes Mellitus	1922	1.30	69.79
17	1693	Other General Conditions	1788	1.21	71.00
18	901	Urinary Tract Infection (Other than Tbc)	1777	1.20	72.20
19	1001	Carcinoma of the Prostate	1630	1.10	73.30
20	1690	Other Bacterial Diseases	1621	1.10	74.40
21	1120	Cancer of the Breast	1405	.95	75.35
22	802	Cardiomyopathies "Primary"	1365	.92	76.27
23	710	Cancer of the Pancreas	1299	.88	77.15
24	1411	Intracapsular and Extracapsular Fractures of the Hip	1288	.87	78.02
25	313	Aneurysm, abdominal	1139	.77	78.79
26	631	Peptic Ulcer	1080	.73	79.52
27	224	Organic Brain Syndrome, Dementia, Senility and Alzheimer's Disease	1048	.71	80.23
28	523	Pulmonary Thromboembolism	989	.67	80.90
29	125	Skin Ulcerations and Gangrene	934	.63	81.53
30	704	Cirrhosis of the Liver	922	.62	82.15
31	290	Other Nervous System Conditions	846	.57	82.72
32	620	Vascular Insufficiency of Intestine	771	.52	83.24
33	1694	Other Complications of Medical Care	737	.50	83.74
34	215	Head Injury, including Intracranial Injury	681	.46	84.20
35	709	Cholecystitis and/or Cholelithiasis	655	.44	84.64
36	803	Tibial Iliac, Femoral or Popliteal Artery Disease	652	.44	85.08
37	625	Cancer of the Stomach	649	.44	85.52
38	242	Alcoholism	634	.43	85.95
39	1692	Other Traumas	591	.40	86.35
40	822	Diseases of Aortic Valve	582	.39	86.74
41	990	Other Urinary Tract Conditions	571	.39	87.13
42	1310	Malignant Lymphoma or Non-Hodgkin's Lymphoma	562	.38	87.51
43	1390	Other Hemapoietic Conditions	555	.38	87.89
44	1311	Multiple Myeloma	521	.35	88.24
45	903	Cancer at Genitourinary Sites - Bladder	507	.34	88.58
46	615	Diverticular Disease	478	.32	88.90
47	904	Cancer at Genitourinary Sites - Kidney, including Nephroblastoma	471	.32	89.22
48	249	Epilepsy/Convulsion	467	.32	89.54
49	1305	Acute Granulocytic Leukemia	433	.29	89.83
50	1124	Cancer of Ovary	400	.27	90.10

Table 10 presents 1984 and 1985 mortality rates by severity of principal disease for this set of 20 diseases. The figures exhibit a typically monotonic increase in mortality rate by stage of disease. The table also indicates an increase in overall mortality rate between 1984 and 1985. However, it shows a decrease in number and proportion of low-stage admissions in most diseases between 1984 and 1985. The clear implication is that reductions of low-severity patients in 1985 led to an increase in the overall patient mortality rate.

In addition to the top 20 diseases, 11 diseases exhibiting significant inter-hospital variation in mortality rates were selected for disease specific classification analyses. This set of diseases was selected from the next 30 highest 1984 mortality-count diseases, which accounted for approximately 10 percent of total mortalities in 1984. Hospital-level mortality rate variation should be determined by comparing mortality rates among hospitals for a given disease. However, most hospitals in the sample had too few observations for a given disease to obtain accurate estimates of hospital-specific death rates. An alternative would have been to analyze mortality rate variation among different hospital classes defined by teaching status, ownership, or bed size. But none of these hospital characteristics were available on the 20 percent MEDPAR files. Therefore, the number of discharges within a disease category was used as a proxy for hospital experience for that disease. Diseases were chosen based on variation between hospitals with different levels of experience.

For each of the 30 disease categories ranked 21 to 50, hospitals were grouped into quartiles based on the total number of discharges within that disease. Disease Categories with high between-group variation were then selected for further modeling. As Table 11 shows, 11 of the 30 Disease Categories had statistically significant between-group differences in mortality rates as measured by the Chi-Square statistic at a 5 percent level. (Note: Some of the DXCATs have only three groups because two of the quartiles were equal, i.e., half of the hospitals had only one observation for the disease.) Therefore, these 11 diseases were also selected for detailed study.

TABLE 10

30 DAY MORTALITY RATE PER 1000 DISCHARGES FOR 20 DISEASES

DXCAT1	DISEASE	STAGE	MORT RATE FY85	MORT RATE FY84	DIFF FY85 - FY84	SIG	NUMBER OF DISCHARGES FY85	NUMBER OF DISCHARGES FY84
	ALL 20 DISEASE CATEGORIES	ALL	103.1	99.9	3.2	**	989504	1058237
415	CORONARY ARTERY DISEASE	ALL	101.8	104.1	-2.4		200306	208063
	ACUTE MYOCARDIAL INFARCTION	1	14.2	19.1	-4.9	**	45487	57646
		2	38.2	46.2	-8.0	**	84624	79266
		3	235.1	237.5	-2.4		70195	71151
251	CEREBROVASCULAR DISEASE	ALL	122.9	118.3	4.7	*	78419	86923
	(CEREBRAL OR PRECEREBRAL ARTERIES)	1	111.5	91.8	19.6	**	24401	21787
		2	120.8	125.3	-4.5		40886	53217
		3	150.8	135.1	15.7	**	13132	11919
504	BACTERIAL PNEUMONIA	ALL	157.4	151.6	5.8	*	73930	67874
		1	121.3	122.5	-1.1		63188	60591
		2	133.0	158.8	-25.8		1436	932
		3	405.8	428.0	-22.2	*	9306	6351
330	OTHER CARDIOVASCULAR CONDITIONS	ALL	116.7	120.9	-4.2	*	70944	88473
		1	23.9	28.8	-4.9	**	28164	34505
		2	110.2	111.8	-1.6		38489	48501
		3	783.5	782.5	1.0		4291	5467
527	CANCER OF THE LUNG, BRONCHUS AND MEDIASTINUM	ALL	244.9	234.6	10.4	*	25798	29908
		1	171.1	179.5	-8.4		9262	13381
		2	219.2	227.1	-7.9		4088	3792
		3	308.3	294.6	13.7		12448	12735
525	BRONCHITIS AND CHRONIC OBSTRUCTIVE	ALL	69.9	63.3	6.6	**	69077	78401
	PULMONARY DISEASE	1	25.2	20.2	5.0	*	11386	14822
		2	41.5	42.6	-1.1		9029	10717
		3	85.6	79.5	6.1	**	48662	52862
590	OTHER RESPIRATORY CONDITIONS	ALL	102.7	94.4	8.4	**	49228	52081
		0	0.0	0.0	0.0		18	15
		1	60.1	54.1	6.0	**	33128	35127
		2	104.1	104.2	-0.0		10850	12423
		3	370.2	381.3	-11.1		5232	4513
		4	.	333.3	.		.	3
821	ARRHYTHMIAS AND CONDUCTION DISORDERS	ALL	61.1	59.7	1.4		83409	82111
		1	23.1	22.9	0.2		28305	32265
		2	28.2	27.9	0.3		15841	14434
		3	101.7	106.3	-4.5		39263	35412
1698	METASTATIC CARCINOMA WITH UNSTATED PRIMARY	ALL	270.4	247.8	22.6	**	12288	14210
		1	101.9	121.0	-19.2		108	157
		2	199.4	167.8	31.7	*	2512	3123
		3	290.8	272.5	18.3	*	9668	10930
690	OTHER GASTROINTESTINAL CONDITIONS	ALL	83.1	72.4	10.7	**	48346	53583
		1	45.2	36.0	9.1	**	14192	17930
		2	90.4	84.0	6.4	*	32459	34004
		3	261.4	228.0	33.3		1695	1649
1290	OTHER ENDOCRINE AND METABOLIC CONDITIONS	ALL	115.8	96.1	19.7	**	39055	34977
		1	115.8	95.8	20.0	**	35873	32092
		2	217.7	210.2	7.5		1093	899
		3	62.2	49.3	12.9		2089	1986
902	ACUTE RENAL FAILURE	ALL	212.9	199.1	13.8		10236	11654
		1	258.3	229.4	28.8	**	6180	7828
		2	104.1	103.4	0.7		2575	2621
		3	212.7	210.0	2.7		1481	1205
429	ESSENTIAL HYPERTENSION	ALL	64.8	60.5	4.3	*	56484	59653

TABLE 10

30 DAY MORTALITY RATE PER 1000 DISCHARGES FOR 20 DISEASES

DXCAT1	DISEASE	STAGE	MORT RATE FY85	MORT RATE FY84	DIFF FY85 - FY84	SIG	NUMBER OF DISCHARGES FY85	NUMBER OF DISCHARGES FY84
		1	7.8	12.6	-4.8	*	6307	10408
		2	48.0	49.5	-1.5		15748	17995
		3	82.9	82.8	0.1		34429	31250
624	CANCER OF THE COLON AND RECTUM	ALL	114.2	123.8	-9.6	*	21509	23564
		1	80.3	93.7	-13.5	**	14042	15113
		3	178.0	188.8	-10.9		7467	7451
1691	OTHER NEOPLASMS	ALL	123.8	114.8	9.1		11712	16610
		0	8.4	6.6	1.8		716	916
		1	131.4	120.8	10.5		10993	15686
		3	0.0	625.0	-625		3	8
1214	DIABETES MELLITUS	ALL	53.2	45.9	7.3	**	41999	47994
		1	7.0	19.7	-12.7		718	4726
		2	26.6	25.7	0.9		31749	34803
		3	145.4	143.5	1.9		9532	8465
1693	OTHER GENERAL CONDITIONS	ALL	38.9	50.0	-11.1	**	39967	41237
		0	18.8	18.6	0.1		30651	23534
		1	64.5	70.0	-5.6		8004	16234
		2	110.0	84.7	25.3		200	236
		3	393.4	370.7	22.8		1098	1214
		4	714.3	894.7	-180		14	19
901	URINARY TRACT INFECTION (OTHER THAN TBC)	ALL	81.7	64.5	17.2	**	31860	32965
		1	55.4	41.7	13.8	**	16795	19601
		2	24.4	22.8	1.6		6772	6769
		3	181.6	175.1	6.5		8293	6595
1001	CARCINOMA OF THE PROSTATE	ALL	71.7	77.4	-5.7		19506	22020
		1	20.9	30.9	-10.0	**	12012	13981
		2	51.0	31.2	19.8		471	513
		3	159.9	166.9	-7.0		7023	7526
1690	OTHER BACTERIAL DISEASES	ALL	255.2	234.8	20.4		5431	5936
		1	46.8	45.3	1.5		1153	1522
		3	311.4	300.2	11.2		4278	4414

TABLE 11

HOSPITAL MORTALITY RATE VARIATION
FOR 30 DISEASES WITH MODERATE MORTALITY RATE
IN THE FY 1985 MEDPAR FILE
HOSPITAL GROUPS ARE PATIENT FREQUENCY QUARTILES

DISEASE CATEGORY	# OF HOSP GRPS	N TOTAL	RATE TOTAL	N GRP 1	N GRP 2	N GRP 3	N GRP 4	RATE GRP 1	RATE GRP 2	RATE GRP 3	RATE GRP 4	CHI-SQ STAT.	P-VALUE
813:Aneurysm, abdominal	4	13412	0.178	859	962	1654	9937	0.281	0.208	0.186	0.165	79.55	0.00
242:Alcoholism	4	28312	0.044	1110	1286	3425	22491	0.062	0.056	0.058	0.040	35.86	0.00
1305:Acute Granulocytic Leukemia	3	2836	0.315	448	376	2012	.	0.422	0.293	0.296	.	28.05	0.00
808:Tibial Iliac, Femoral or Popliteal Ar	4	29010	0.062	801	1911	3736	22562	0.106	0.066	0.064	0.059	31.10	0.00
704:Cirrhosis of the Liver	4	8826	0.193	936	962	801	6127	0.252	0.210	0.180	0.183	27.25	0.00
822:Diseases of Aortic Valve	4	14840	0.081	994	1002	1578	11266	0.116	0.079	0.085	0.077	18.45	0.00
710:Cancer of the Pancreas	4	8286	0.324	989	940	735	5622	0.368	0.355	0.295	0.315	17.81	0.00
903:Cancer at Genitourinary Sites - Bladd	4	24182	0.048	801	2286	2281	18814	0.071	0.057	0.051	0.045	16.47	0.00
290:Other Nervous System Conditions	4	35628	0.036	1147	2872	3748	27861	0.045	0.039	0.044	0.034	13.91	0.01
215:Head Injury, including Intracranial I	4	13946	0.078	1453	1380	1281	9832	0.059	0.069	0.072	0.083	12.46	0.01
620:Vascular Insufficiency of Intestine	3	4664	0.322	1018	658	2988	.	0.361	0.296	0.314	.	10.23	0.02
528:Pulmonary Thromboembolism	4	10404	0.140	1288	1296	933	6887	0.165	0.147	0.125	0.136	9.68	0.05
1310:Malignant Lymphoma or Non-Hodgkin's L	4	9836	0.157	844	790	621	7581	0.186	0.161	0.177	0.152	8.97	0.06
802:Cardiomyopathies "Primary"	4	23678	0.144	895	2101	2150	18532	0.172	0.153	0.138	0.142	8.22	0.08
1692:Other Traumas	4	27746	0.035	1213	1982	3707	20844	0.026	0.028	0.032	0.037	8.23	0.08
1411:Intracapsular and Extracapsular Fract	4	71826	0.056	2704	4699	8142	56281	0.063	0.062	0.054	0.055	7.83	0.10
1311:Multiple Myeloma	3	6152	0.166	742	1116	4294	.	0.195	0.172	0.160	.	6.23	0.10
1694:Other Complications of Medical Care	4	43740	0.025	1711	1787	4329	35913	0.032	0.026	0.028	0.024	5.50	0.24
626:Cancer of the Stomach	3	6844	0.219	915	914	5015	.	0.234	0.239	0.213	.	4.28	0.23
631:Peptic Ulcer	4	51122	0.054	2373	3653	5504	39592	0.051	0.051	0.060	0.054	4.75	0.31
224:Organic Brain Syndrome, Dementia, Sen	4	22740	0.058	1223	1368	2645	17504	0.065	0.066	0.062	0.056	4.31	0.37
125:Skin Ulcerations and Gangrene	4	25686	0.106	1206	1606	2994	19880	0.120	0.112	0.108	0.104	4.27	0.37
1390:Other Hemapoietic Conditions	4	14910	0.064	1343	1458	1203	10906	0.071	0.074	0.064	0.062	4.22	0.38
1124:Cancer of Ovary	3	5868	0.150	832	652	4384	.	0.169	0.153	0.146	.	3.02	0.39
249:Epilepsy/Convulsion	4	23264	0.040	1238	1508	2817	17701	0.032	0.041	0.042	0.041	2.68	0.61
904:Cancer at Genitourinary Sites - Kidne	3	5908	0.125	908	784	4216	.	0.127	0.139	0.122	.	1.80	0.61
1120:Cancer of the Breast	4	32098	0.075	1039	2480	3548	25031	0.083	0.075	0.069	0.075	2.50	0.64
708:Cholecystitis and/or Cholelithiasis	4	69188	0.025	1932	5175	9342	52739	0.021	0.025	0.025	0.025	1.52	0.82
990:Other Urinary Tract Conditions	4	22732	0.034	1282	1492	2951	17007	0.037	0.039	0.034	0.034	1.30	0.86
615:Diverticular Disease	4	50094	0.022	2329	3653	5338	38774	0.021	0.023	0.022	0.023	0.33	0.99

ii. Analytical Models for the 31 High-Mortality Diseases

Using all five stratification variables, the 31 diseases induce 1,674 cells or strata (31 Diseases x 3 Stages x 3 Comorbidity groups x 3 Age groups x 2 Sex groups). The goal of this analysis was to reduce the number of cells by combining cells whose death rates were not statistically different. Consider the four strata below.

Stratum	Age	Sex
1	≤ 75	M
2	≤ 75	F
3	>75	M
4	>75	F

There are 15 total ways of combining these strata, although some combinations seem more acceptable than others. For example, it seems reasonable to combine sex groups within an age group, to combine age groups within a sex group, or to combine all groups into one, but it would seem odd to form a new stratum by combining strata 1 and 4 (young males and old females).

The analysis here was disease-specific. Therefore, combinations of strata across diseases were not considered. Within each disease there were a total of 54 strata. There were an enormous number of possible arbitrary combinations of these strata. Therefore, a scheme to allow a reasonable number of tests for combinations of "adjacent" strata was developed.

Under this scheme, in the age-sex strata above, sex would be considered nested within age. The first test that was conducted assessed whether the sex groups could be combined within each age group. Therefore, strata 1 and 2 would be combined if their death rates were not statistically different. Likewise, strata 3 and 4 might be combined based upon the same criteria. The age groups would be tested for possible combination only if the sex groups were combined within both age groups. Therefore, the final stratification would have five possibilities (the parentheses indicate separate groups):

(1), (2), (3), (4)
(1, 2), (3), (4)
(1), (2), (3, 4)
(1, 2), (3, 4)
(1, 2, 3, 4)

The combinations allowed by this procedure depend critically on the hierarchy of the variables. For example, if age groups were nested within sex groups then the final stratification would have the following five possibilities:

(1), (2), (3), (4),
(1, 3), 2, 4
1, 3, (2, 4)
(1, 3), (2, 4)
(1, 2, 3, 4)

iii. Nesting of Risk Factors

The hierarchy (or nesting) of variables was determined primarily by their expected ability to explain variation in death rates. Integer Stage was placed first in the hierarchy within each disease because the risk of mortality and morbidity theoretically increases with Stage, and Stage is always nested within disease by definition. Thus, Stage categories would be the last categories to consider for combinations.

The second stratification variable (nested within Stage) was the number of High-Risk Unrelated Comorbidities. Only High-Risk Unrelated Comorbidities were included because preliminary analyses showed that they have a strong tendency to increase mortality risk whereas Low-Risk comorbidities tended to have relatively little effect on the risk of death.

The third variable in the hierarchy was Age. The risk of dying tends to increase with age for nearly all Disease Categories.

The fifth and final variable nested within all of the preceding variables was Sex. Sex has been shown to be a significant risk factor for many diseases, but certainly not for all diseases. Therefore, sex groups were the first to be considered for combination.

iv. Statistical Model

The tests for combining "adjacent" strata were carried out by fitting a statistical logistic regression model to the data in each of the 31 Disease Categories. The probability of 30-day mortality was modeled as a function of Sex group, (nested within) Age group, (nested within) Comorbidity group, (nested within) Disease Stage. First a (fully-saturated) model was fit to the data that estimated a different mortality rate for each of the 54 strata. Adjacent cells were combined whose death rates were not statistically different (at the 5 percent level). A new model was then fit to the data that estimated a different mortality rate for each of the reduced number of strata. If the mortality rates estimated from the reduced model were an adequate summary of the original 54 mortality rates as measured by a Chi-square goodness-of-fit test then the resulting strata were judged to be risk-homogeneous and the reduced classification system was adopted for that disease. Appendix A shows the effect of this collapsing for each of the 31 Disease Categories.

The reduced classification system was used to calculate expected within-cell FY 1985 mortality counts based on within-cell FY 1984 mortality rates.

As an example, Table 12 shows the effect of this stratification process on DX 251: Cerebrovascular Disease. The final stratification contains 25 strata, a reduction of 29 from the original 50 classes.

To obtain a disease specific estimate of the year effect, an indicator for FY 1985 was added as a predictor variable to the final logistic regression for each of the 31 diseases. If the estimated coefficient was statistically significant, then the FY 1985 mortality rate was judged to be statistically different from the FY 1984 mortality rate for that disease, after controlling for (case mix) stage, high-risk comorbidities, age, and sex.

TABLE 12

FINAL STRATIFICATION FOR DX 251: CEREBROVASCULAR DISEASE

CELL #	STAGE	# UNRELATED HIGH RISK COMORBS.	AGE	SEX	84-85 TOTAL DISCHGS.	84-85 MORT. RATE	STRATUM #	84-85 TOTAL DISCHGS.	84-85 MORT. RATE
1	1	0	<70	MALE	5949	0.038	1		
2	1	0	<70	FEMALE	4262	0.037	1	10211	0.038
3	1	0	70-79	MALE	9353	0.063	2		
4	1	0	70-79	FEMALE	8698	0.058	2	18051	0.060
5	1	0	80+	MALE	4302	0.136	3		
6	1	0	80+	FEMALE	7307	0.147	3	11609	0.142
7	1	1	<70	MALE	896	0.154	4	896	0.154
8	1	1	<70	FEMALE	517	0.195	5	517	0.195
9	1	1	70-79	MALE	1368	0.206	6		
10	1	1	70-79	FEMALE	1104	0.197	6	2472	0.202
11	1	1	80+	MALE	757	0.329	7		
12	1	1	80+	FEMALE	1194	0.321	7	1951	0.324
13	1	2	<70	MALE	68	0.368	8		
14	1	2	<70	FEMALE	38	0.421	8		
15	1	2	70-79	MALE	96	0.396	8		
16	1	2	70-79	FEMALE	102	0.441	8	476	0.447
17	1	2	80+	MALE	72	0.486	8		
18	1	2	80+	FEMALE	100	0.540	8		
19	2	0	<70	MALE	8366	0.070	9		
20	2	0	<70	FEMALE	6938	0.073	9	15304	0.071
21	2	0	70-79	MALE	15555	0.091	10		
22	2	0	70-79	FEMALE	17469	0.086	10	33024	0.088
23	2	0	80+	MALE	11437	0.137	11	11437	0.137
24	2	0	80+	FEMALE	22093	0.118	12	22093	0.118
25	2	1	<70	MALE	1184	0.209	13		
26	2	1	<70	FEMALE	881	0.241	13		
27	2	1	70-79	MALE	2153	0.244	13	6366	0.232
28	2	1	70-79	FEMALE	2148	0.231	13		
29	2	1	80+	MALE	1798	0.309	14		
30	2	1	80+	FEMALE	3219	0.304	14	5017	0.306
31	2	2	<70	MALE	78	0.372	15		
32	2	2	<70	FEMALE	77	0.390	15	155	0.381
33	2	2	70-79	MALE	164	0.518	16		
34	2	2	70-79	FEMALE	170	0.447	16		
35	2	2	80+	MALE	134	0.575	16	703	0.506
36	2	2	80+	FEMALE	235	0.502	16		
37	3	0	<70	MALE	2355	0.076	17		
38	3	0	<70	FEMALE	1681	0.076	17	4036	0.076
39	3	0	70-79	MALE	4459	0.103	18		
40	3	0	70-79	FEMALE	4410	0.098	18	8869	0.100
41	3	0	80+	MALE	2827	0.153	19		
42	3	0	80+	FEMALE	5645	0.164	19	8472	0.160
43	3	1	<70	MALE	364	0.206	20		
44	3	1	<70	FEMALE	256	0.250	20	620	0.224
45	3	1	70-79	MALE	666	0.249	21		
46	3	1	70-79	FEMALE	673	0.212	21	1339	0.231
47	3	1	80+	MALE	544	0.377	22	544	0.377
48	3	1	80+	FEMALE	973	0.308	23	973	0.308
49	3	2	<70	MALE	25	0.200	24		
50	3	2	<70	FEMALE	17	0.353	24		
51	3	2	70-79	MALE	40	0.450	24	125	0.360
52	3	2	70-79	FEMALE	43	0.372	24		
53	3	2	80+	MALE	27	0.630	25		
54	3	2	80+	FEMALE	46	0.435	25	73	0.507

b. Classification of Low Mortality Diseases

To complete the mortality-risk homogeneous classification system, it was necessary to also classify the remaining 359 "Low Mortality" diseases into risk-homogeneous strata.

The stratification was performed using the three most important risk factors used in the stratification of the 31 High-Mortality disease categories: principal disease category, stage, and number of high risk comorbidities. Body system was also used as a stratification variable.

To ensure a minimum level of accuracy for all cell-level mortality-rate estimates, a minimum average cell size was set at 0.1% of total mortalities was selected. Since total mortalities in the 1984-1985 20% MEDPAR file equaled approximately 300,000 a minimum average cell size of 300 was used.

The remaining 359 Disease Categories were put into four major groups. Each group had a separate classification system. The first group was stratified on Disease Category * Stage * Number of Unrelated Comorbidities. Comorbidities were 0 for none and 1 for one or more. This first group therefore was comprised of those diseases with a mortality count of at least 1,800 (300 minimum average cell size * 3 stages * 2 comorbidities). The second group consisted of all those diseases with at least 900 mortalities (300 * 3 Stages) and they were stratified by stage. The third group consisted of those diseases with at least 300 mortalities (one cell per disease) and they were stratified by disease. The remaining 309 diseases were then stratified by the 16 body system codes.

The final low-mortality classification system contained 26 cells in Group 1, 37 cells in Group 2, 31 cells in Group 3 and 16 cells in Group 4 for a total of 110 cells for the 359 diseases.

3. Analysis of 1984-1985 Mortality Rates

Two sets of analyses were conducted using the risk-homogeneous classification system. In the first, a separate logistic model of the probability of death for each of the 31 diseases was analyzed in which a dummy variable for the year effect (1984-1985 contrast) was included along with the various cells in the classification for that disease.

In the second analysis of the risk-adjusted classification system, the 1985 mortality counts were indirectly standardized by multiplying the number of 1985 admissions per classification by the 1984 mortality rate per classification. These expected mortality counts were then summed over all strata in the classification system to obtain an estimate of the overall 1985 expected mortality count.

V. RESULTS

In this section the analytical results of the 1984-1985 comparisons of 30-day post admission mortality rates are presented and described. The section begins with a description of 1984-1985 changes in severity mix and unadjusted 30-day mortalities. Analytical results are then separately discussed for the fully interactive model estimated at hierarchical levels, and the risk-homogeneous classification system.

A. Severity Mix and Unadjusted Mortality

The crude (unadjusted) 1984 Medicare 30-day mortality rate based on the 20% MEDPAR sample was 66 deaths per 1,000 admissions. This rate increased to 72 deaths per 1,000 admissions in 1985. This amounts to a 9.3 percent increase in the crude 30-day mortality rate in the first two years of PPS.

The case-mix severity over the same period exhibited an increase as well. This is exemplified in Table 10 by the decrease in numbers of patients at low stages of disease. For example, the number of patients (in the 20% sample) that were hospitalized with coronary artery disease dropped from 208,063 in 1984 to 200,306 in 1985. This was almost entirely due to a decrease in number of Stage 1 patients from 56,646 to 45,487 (nearly a 20% drop). In fact the number of patients in Stages 2 or 3 increased slightly from 150,417 in 1984 to 154,819 in 1985.

Since low severity patients are generally at low risk of mortality, this increase in average severity level may partially explain the overall observed increase in mortality rate. In general, the mortality rates by severity level and disease do not differ in a consistent direction from 1984 to 1985. It appears, rather, to be the change in mix of patients, to higher severity categories in 1985, that underlies the overall increase in the crude mortality rate from 1984 to 1985.

B. Fully interactive models

Table 13 presents results of the analyses using different hierarchical levels of the model in which all interactions between independent variables were included. The table presents the stratification variables that were included in the analytical model. Shown on the table are the number of strata defined by each combination of variables, the 1985 observed 30-day mortality count, the 1985 expected 30-day mortality count using each model configuration to indirectly standardize 1985 mortalities, and the standardized mortality ratio (SMR) which compares the observed and expected mortality figures.

The first line of the table indicates that without risk adjustment the SMR equals 1.0927. That is, the 1985 unadjusted 30-day mortality count was 9.27 percent higher than would be expected if the overall crude mortality rate stayed constant from 1984 to 1985. As mentioned above, the 30-day mortality rate increased from 6.61 percent in 1984 to 7.22 percent in 1985 (the factor of increase is 9.27 percent).

The results of the model indicate that by controlling for 1984-1985 differences in the mix of principal disease categories (398 total strata), the SMR falls substantially from 1.0927 to 1.0499. Principal disease thus account for approximately 46 percent of the change in mortality from 1984 to 1985.

When the mix of principal diseases and stages within those diseases are both controlled for (992 total strata), the SMR is reduced to 1.0179. The change in severity of principal disease thus explains an additional 35 percent of the 1984-1985 change in mortality.

After controlling for changes in the number of high risk comorbidities within each stage and principal disease (2,772 total strata) the SMR falls below 1.0 to 0.9817. Thus, the changes in case-mix (as defined by these three variables) between 1984 and 1985 would lead us to expect a higher mortality count in 1985 than was actually observed.

TABLE 13

Standardized 30-Day Mortality Ratio FY 1985

Stratification Variables	Number of Strata	Mortality Observed FY 1985	Mortality Expected FY 1985[1]	SMR[2]
None (Unadjusted)	1	142,775	130,666	1.0927
DXCAT1	398	142,775	135,988	1.0499
DXCAT1, INTSTAGE[4]	992	142,775	140,266	1.0179
DXCAT1, INTSTAGE, HIRISK[5]	2,772	142,775	145,432	.9817
DXCAT1, INTSTAGE, AGE[6]	2,803	142,775	141,049	1.0122
DXCAT1, INTSTAGE, SEX[7]	1,893	142,775	140,270	1.0179
DXCAT1, INTSTAGE, HIRISK, AGE	7,119	142,775	145,919	.9785
DXCAT1, INTSTAGE, HIRISK, AGE, SEX	12,390	142,775	145,625	.9804

[1] Product of FY 1985 discharge frequency and FY 1984 mortality rate within each stratum is summed over all strata to obtain expected frequency for FY 1985.

[2] Standardized Mortality Ratio = Observed/Expected.

[3] DXCAT1 - Disease category of principal diagnosis (398 categories).

INTSTAGE - Integer disease stage (3 categories: 1, 2, 3).

[5] HIRISK - Number of "high risk" comorbidities (4 categories: 0, 1, 2, ≥ 3).

[6] AGE - Age of patient (3 categories: age ≤ 69, 70 ≤ age ≤ 79, age ≥ 80).

[7] SEX - Sex of patient (2 categories: male, female).

NOTE: 2,225,571 FY 1984 Discharges and 1,976,447 FY 1985 Discharges. The Crude rate was: .0661116 in FY 1984 and .0722382 in FY 1985.

SOURCE: 1984 and 1985 MEDPAR.

The addition of age and sex to the models as stratification variables does little to change the above SMRs further, since the age and sex distributions are nearly identical in 1984 and 1985. In fact, the subtle reductions in the SMR do not justify the enormous increases in the number of strata defined by the model. Thus, while age and sex are important cross-sectional predictors of mortality rates, only type and severity of principal disease and extent of high risk comorbidities are needed to explain the change in mortalities between the two years.

C. Risk-Homogeneous Classification System

As described in the earlier discussion of methodology, two sets of analyses were conducted using the risk-homogeneous classification system. The first estimated the relative risk of death in 1984 vs. 1985 controlling for case-mix differences in a logistic regression model. The second used the classification system to indirectly standardize the 1985 mortality rate based on 1984 within-class mortality rates.

The results of the first set of analyses are presented in Table 14. For each of the 31 diseases, the table presents the number of strata in the classification system, the percent of variance in the probability of death among the original 54 strata explained by the reduced number of model strata (R^2), the unadjusted and the adjusted ratios of 1985 to 1984 odds of dying, and the statistical significance of the adjusted odds ratios. The results show that the adjusted odds ratios are all smaller than the unadjusted odds ratio for each disease. Many of the odds ratios fall below 1.0 indicating that the 1985 adjusted odds of dying are lower than the 1984 adjusted odds. This is depicted graphically in Figure 1. For all diseases the model adjustment reduces the odds ratio. For some diseases, the model has adjusted the 1985 odds of dying below that of 1984, while in others the 1985 adjusted log odds of dying still exceed the 1984 odds.

TABLE 14

Mortality Risk-Homogeneous Classifications: Number of Strata and Descriptive Statistics by Disease

Top 20 Dx Categories		# of STRATA	R^2	Unadj. Odds Ratio	Adj. Odds Ratio	P-Value
251:	Cerebrovascular Disease	25	.995	1.05	.990	.5090
504:	Bacterial Pneumonia	37	.999	1.05	.931	.0001
525:	Bronchitis/Obstruc Pulmonary Dx	36	.994	1.11	1.045	.0375
527:	Cancer - Lung	29	.988	1.06	.989	.5772
590:	Other Respiratory Conditions	37	.998	1.10	.949	.0247
624:	Cancer - Colon and Rectum	22	.993	0.91	.845	.0001
690:	Other Gastrointestinal Cond.	33	.997	1.16	.995	.8552
815:	Coronary Artery Disease (Acute MI)	36	.999	0.97	.913	.0001
821:	Arrhythmias/Condition Disorders	32	.997	1.02	.932	.0009
829:	Essential Hypertension	25	.986	1.08	.965	.1439
890:	Other Cardiovascular Cond.	32	.999	0.96	.903	.0001
901:	Urinary Tract Infection	28	.993	1.29	1.097	.0038
902:	Acute Renal Failure	23	.987	1.09	.992	.8254
1001:	Carcinoma of the Prostate	14	.995	0.92	.870	.0004
1214:	Diabetes Mellitus	29	.996	1.17	.985	.6430
1290:	Other Endocrine/Metabolic Cond.	32	.993	1.23	1.107	.0001
1690:	Other Bacterial Diseases	15	.989	1.12	.941	.2051
1691:	Other Neoplasms	9	.990	1.09	.995	.8985
1693:	Other General Conditions	24	.994	0.77	.756	.0001
1698:	Carcinoma - Unstated Primary	19	.970	1.13	1.060	.0424
	Subtotal	537				
Next 11 Most Variable						
215:	Head Injury, including Intracranial	15	.975	0.974	0.901	.1093
242:	Alcoholism	10	.976	1.075	1.009	.8816
290:	Other Nervous System Conditions	15	.987	1.207	1.091	.1259
620:	Vascular Insufficiency of Intestine	17	.953	0.965	0.877	.0788
704:	Cirrhosis of the Liver	24	.963	1.157	1.013	.8251
710:	Cancer of the Pancreas	21	.946	1.064	1.004	.9380
808:	Tibial, Iliac, Fem or Pop Artery Dx	18	.985	1.036	0.941	.2331
813:	Aneurysm, Abdominal	14	.987	1.016	0.994	.9103
822:	Disease of Aortic Valve	11	.951	0.985	0.912	.1347
903:	Cancer at Genitourinary Sites	17	.983	1.053	0.929	.2362
1305:	Acute Granulocytic Leukemia	18	.902	1.120	1.063	.4688
	Subtotal	180				
	Total	717				

FIGURE 1

UNADJUSTED vs ADJUSTED 84/85 ODDS RATIO

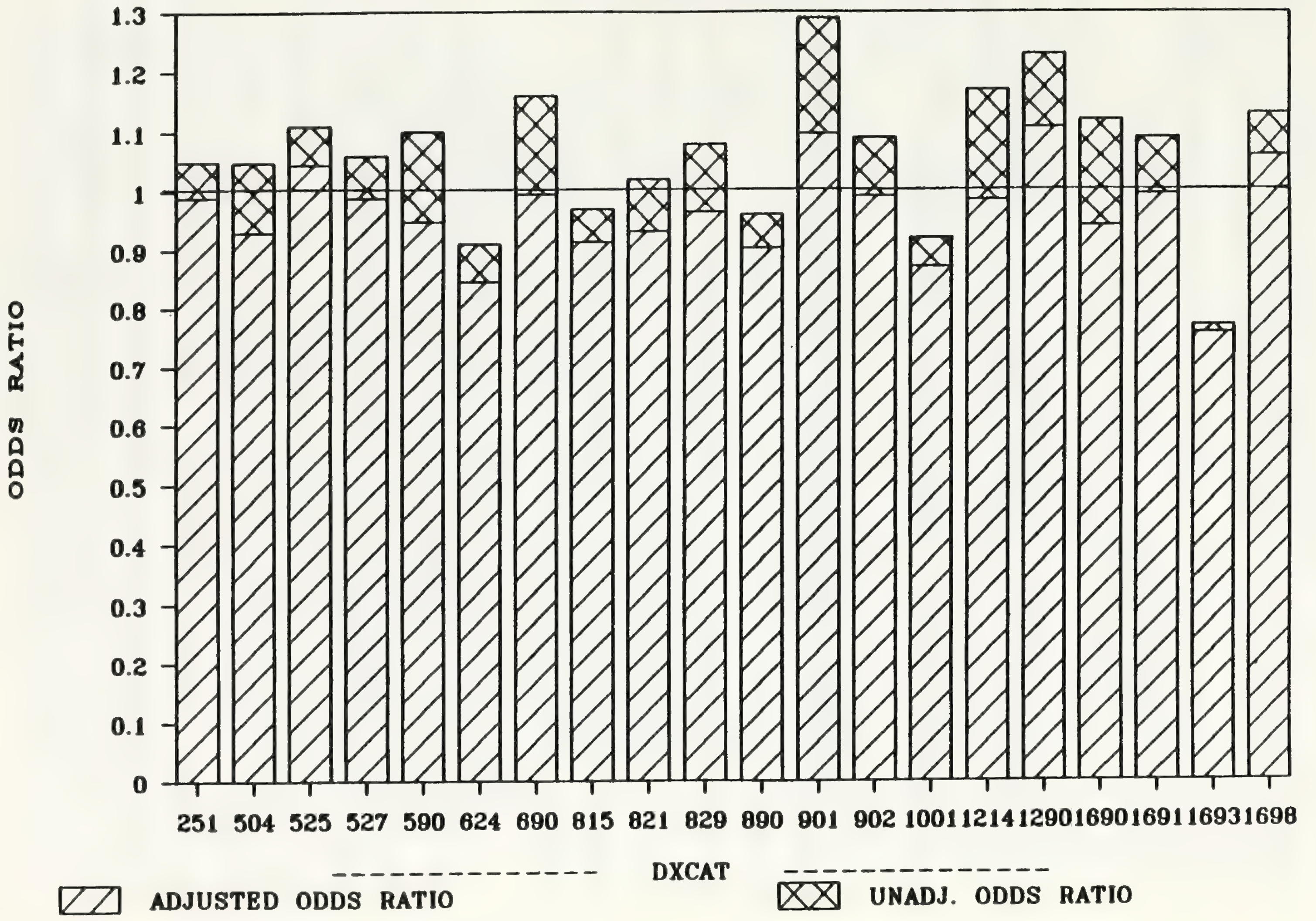


Table 15 presents the results of the second set of analyses. The table displays for each of the 31 high mortality diseases and the set of four-low mortality classifications the number of admissions in the 1985 20 percent MEDPAR file, the 1985 observed and expected mortality counts, and the standardized mortality ratios (SMRs) which compare the two figures. As can be seen, the SMRs are typically very near 1.0, with many falling below that value. The SMRs are usually about the same as the adjusted odds ratios shown in Table 14 and the significance levels are comparable in both tables.

SMRs of less than 1.0 indicate that fewer cases died in 1985 than one would expect on the basis of case-mix severity. For instance, the SMR for the first listed disease, 215: Head Injury Including Intracranial, is 0.93, indicating that seven percent fewer cases died of this condition in 1985 than expected based on the severity of the cases.

The bottom four sets of classifications in the table describe different levels of stratification detail that were defined for low-mortality diseases. As can be seen, the SMR remain above 1 for these four sets of diseases. This might be explained by the declining detail of stratification, indicating that less risk-adjustment is being contributed by these classification sets. In any case, the mortality rates for those strata are quite small and their impact on the entire mortality analysis is correspondingly small.

In total, the mortality classification system has the impact of reducing the SMR from 1.0927 to 0.9917. This value is significantly lower than 1.0, but this significance relies on the assumption that the within-stratum 1984 mortality rates are measured without error and that these are the "true" within stratum mortality rates. This value indicates that the observed mortality rate is lower than would be expected by changes in case mix as measured by the risk-homogeneous classification system. The value is only slightly different from the SMR of 0.9804 for the fully stratified interactive model with 12,390 strata. Thus, the significant reduction in number of strata has not affected the system's ability to explain changes in 1984-1985 mortality rates.

TABLE 15

ACTUAL, EXPECTED MORTALITY FOR 1985

DISEASE CATEGORY		TOTAL DISCH.	ACTUAL MORTALITY	EXPECTED MORTALITY	SMR	SIGNIFI-CANCE
215	Head Injury, including Intracranial	6973	543	588.1	0.92	
242	Alcoholism	14156	625	629.0	0.99	
251	Cerebrovascular Disease	78418	9641	9641.6	1.00	
290	Other Nervous System Conditions	17814	634	593.4	1.07	
504	Bacterial Pneumonia	73929	11634	12281.5	0.95	**
525	Bronchitis/Obstuc Pulmonary Dx	69077	4827	4643.5	1.04	*
527	Cancer - Lung	25798	6319	6365.9	0.99	
590	Other Respiratory Conditions	49227	5058	5250.7	0.96	*
620	Vascular Insufficiency of Intestine	2332	750	801.1	0.94	
624	Cancer - Colon and Rectum	21509	2456	2812.2	0.87	**
690	Othe Gastrointestinal Condition	48346	4019	4032.3	1.00	
704	Cirrhosis of the Liver	4413	853	846.4	1.01	
710	Cancer of the Pancreas	4143	1343	1337.2	1.00	
808	Tibial, Iliac, Fem or Pop Artery Dx	14505	893	936.0	0.95	
813	Aneursym, Abdonimal	6706	1195	1205.6	0.99	
815	Coronary Artery Disease (Acute MI)	200306	20384	21874.5	0.93	**
821	Arrhythmias/Condition Disorders	83409	5097	5421.2	0.94	*
822	Disease of Aortic Valve	7420	600	646.4	0.93	
829	Essential Hypertension	56484	3658	3776.9	0.97	
890	Other Cardiovascular Condition	70943	8276	8797.9	0.94	**
901	Urinary Tract Infection	31860	2602	2424.4	1.07	*
902	Acute Renal Failure	10236	2179	2184.5	1.00	
903	Cancer at Genitourinary Sites	12091	580	613.3	0.95	
1001	Carcinoma of the Prostate	19506	1398	1575.1	0.89	*
1214	Diabetes Mellitus	41997	2235	2276.1	0.98	
1290	Other Endocrine/Metabolic Condition	39054	4522	4146.4	1.09	**
1305	Acute Granulocytic Leukemia	1418	447	420.9	1.06	
1690	Other Bacterial Diseases	5430	1386	1431.4	0.97	
1691	Other Neoplasms	11712	1450	1456.4	1.00	
1693	Other General Conditions	39951	1545	1930.5	0.80	**
1698	Carcinoma - Unstated Primary	12288	3323	3203.0	1.04	*
GRP 1	5 Diseases: Stage*Comorb=26 cats.	102205	7635	7604.3	1.00	
GRP 2	14 Diseases: Stage = 37 cats.	176674	8496	7979.3	1.06	**
GRP 3	31 Diseases	288919	8946	8111.6	1.10	**
GRP 4	16 Body Systems	327198	7226	6173.8	1.17	**
TOTAL		1976447	142775	144012.4	0.9914	*

NOTE RE SIGNIFICANCE LEVELS: * = SIGNIFICANT AT .05 LEVEL
** = SIGNIFICANT AT .01 LEVEL

VI. SUMMARY AND CONCLUSIONS

The results of this study provide no evidence to indicate that the quality of care has declined during the first two years of PPS. While crude 30-day mortality rates increased by 9.3% between 1984 and 1985, all of this increase could be explained by the increase in case-mix severity between the two years. In fact, adjustments for stage of disease, high risk comorbidity, age, and sex resulted in an expected mortality rate for 1985 of 7.3 percent, which is slightly higher than the observed 1985 rate of 7.2 percent. That is, there was a smaller increase in mortality rate between 1984 and 1985 than would have been expcted on the basis of the change in case-mix severity alone.

The results of this study show that much of the 8.8 percent decrease in Medicare admission rates between these two years was primarily caused by a decline in the hospitalization of low severity patients. This may be due to greater public awareness as to the need for hospitalization and a general increase in the outpatient treatment of low severity patients. As a result, the Medicare inpatient population in 1985 was, on average, more severely ill and at greater risk of mortality than in 1984. The rate of mortalities per 100 admissions thus exhibited an increase that could be fully explained by the increase in case-mix severity.

These results do not, of course, rule out the possibility that the quality of hospital care may actually have declined in the first two years of PPS. The mortality rate is a crude aggregate indicator that is somewhat insensitive to changes in the quality of care, and other measures may have provided different results. This study only indicates that the observed increase in crude mortality rates from 1984 to 1985 should not be immediately interpreted as an indication of a decline in quality of care.

The risk-homogeneous classification system that was developed in this study using stage of principal disease, extent of high-risk comorbidity, age, and sex proved to be a powerful tool for the analysis of mortality rates. The classification system was designed to be clinically meaningful and easy to use so that specific patient types exhibiting higher or lower than expected mortality rates could be identified and studied. The system would benefit somewhat from further refinement in selected areas but in its current form it provides a severity adjustment method that is easily implemented with existing hospital discharge data to facilitate the evaluation of hospital outcomes.

There are two limitations to this analysis which may have affected the results of the study. First, there is the possibility that some of the observed increase in stage of illness and comorbidities may be due to coding changes or "DRG creep." A study by Carter and Ginsburg (1985) showed that there was an initial rise in the reimbursement based case-mix which was largely due to coding practice changes. The case-mix index continued to increase through 1985 but less of the change could be attributed to coding practices. Still, coding creep remains as a possible explanation for some of the observed increased severity. This problem is not unique to this study but is relevant to any analysis of hospitalization data which uses case-mix adjustment techniques based on diagnostic codes.

Second, the computerized staging method used in this analysis relies, of necessity, on the information available on the MEDPAR data sets. As such, it defines severity based upon information on the discharge abstract. These data do not cleanly differentiate between conditions present at admission and conditions arising as a result of the stay itself. However, significant attempts were made in the study (particularly for unrelated comorbidities) to eliminate severity which could have been caused by the stay. In addition, recent research on the computerized staging method shows it to be relatively insensitive to changes in the severity of a given disease that occur during a hospital stay; i.e., the stage at discharge usually equals the stage at admission (Cretin and Worthman, 1986; Louis, 1987). This is most likely to be true of chronic diseases and diseases that do not tend to progress rapidly during a hospital stay. It is therefore unlikely that the increase in severity detected from 1984 to 1985 was due to differences in care provided rather than the condition of the patients at admission. At any rate, any potential bias would apply to both years, and thus may have little impact on the comparison between years.

This study exclusively focused on overall changes in mortality rates in the first two years under PPS. Further analyses are needed to assess mortality rate differences between hospitals and classes of hospitals in different regions of the U.S., and to identify patient and provider correlates of high mortality rates. Further refinements to the risk-homogeneous classification system should be made to increase its sensitivity to variations in mortality. Further research regarding the impact of coding changes on stage of illness, and the use of computerized staging to measure admission severity should also be conducted. Finally, other measures of hospital outcomes, such as early readmissions, post-surgical complications, etc., should be analyzed with methods similar to those used in this study to further evaluate the impact of PPS on hospital quality of care.

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APPENDIX

FINAL CLASSIFICATION SYSTEM FOR TOP 20 AND NEXT 11 DISEASES

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                  ACTUAL, EXPECTED 85 MORTALITY BY STRATA                   2
                     FOR TOP 20 AND NEXT 11 DXCATS

----------- DXCAT=251:Cerebrovascular Disease (Cerebral or Precerab -----------

          HIGH RISK                1984   1985   1984  1985  1985  EXPECTED
  STAGE    COMORB.   AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

       1      0      <70 ----      5196   5015 0.034 0.041   208    171.80
       1      0    70-79 ----      8758   9293 0.056 0.065   600    524.18
       1      0    80+   ----      5268   6341 0.137 0.147   932    871.47
       1      1      <70 MALE       407    489 0.135 0.170    83     66.08
       1      1      <70 FEMALE     223    294 0.206 0.187    55     60.65
       1      1    70-79 ----      1002   1470 0.201 0.203   299    294.88
       1      1    80+   ----       777   1174 0.313 0.328   385    373.20
       1      2    ----  ----       151    325 0.364 0.486   158    118.38
       2      0      <70 ----      8862   6442 0.072 0.070   448    466.69
       2      0    70-79 ----     19011  14013 0.091 0.085  1186   1280.34
       2      0    80+   MALE      6398   5039 0.143 0.129   652    719.07
       2      0    80+   FEMALE   12511   9592 0.123 0.112  1069   1174.87
       2      1      <80 ----      3354   3012 0.241 0.223   671    726.51
       2      1    80+   ----      2677   2340 0.313 0.298   697    731.63
       2      2      <70 ----        75     80 0.387 0.375    30     30.93
       2      2    70+   ----       326    377 0.515 0.499   188    194.28
       3      0      <70 ----      1966   2070 0.070 0.082   169    145.30
       3      0    70-79 ----      4317   4552 0.092 0.109   494    418.61
       3      0    80+   ----      4035   4437 0.163 0.158   701    721.36
       3      1      <70 ----       303    317 0.221 0.227    72     70.10
       3      1    70-79 ----       581    758 0.212 0.245   136    150.47
       3      1    80+   MALE       223    321 0.368 0.383   123    118.04
       3      1    80+   FEMALE     415    558 0.277 0.332   185    154.63
       3      2      <80 ----        47     78 0.404 0.333    26     31.53
       3      2    80+   ----        32     41 0.406 0.585    24     16.66
---------                         -----  -----              ----   -------
DXCAT                             86915  73418              9641   9641.64


------------------ DXCAT=250:Other Nervous System Conditions ------------------

          HIGH RISK                1984   1985   1984  1985  1985  EXPECTED
  STAGE    COMORB.   AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

       1      0      <70 MALE      2754   1880 0.018 0.017    32    33.450
       1      0      <70 FEMALE    3670   2471 0.007 0.008    19    18.179
       1      0    70-79 MALE      2772   1940 0.021 0.029    56    41.291
       1      0    70-79 FEMALE    4827   3316 0.014 0.019    62    45.340
       1      0    80+   MALE      1311    926 0.051 0.051    47    47.324
       1      0    80+   FEMALE    2932   2048 0.029 0.031    64    59.372
       1      1      <70 ----       785    711 0.070 0.084    60    49.815
       1      1    70-79 MALE       433    409 0.109 0.105    43    44.395
       1      1    70-79 FEMALE     566    516 0.064 0.064    33    32.620
       1      1    80+   MALE       215    197 0.126 0.091    18    24.740
       1      1    80+   FEMALE     451    370 0.058 0.086    32    21.330
       1      2    ----  ----       194    226 0.232 0.327    74    52.423
       2      0      <80 ----      1898   1848 0.024 0.011    20    44.788
       2      0    80+   ----       541    574 0.039 0.038    22    22.281
       2      1    ----  ----       264    356 0.136 0.126    45    48.818
       2      2      <80 ----        15     20 0.200 0.200     4     4.000
       2      2    80+   ----         8      4 0.750 0.750     3     3.000
       3   ----    ----  ----         0      0 0.000 0.000     0     0.000
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                  ACTUAL, EXPECTED 85 MORTALITY BY STRATA                 1
                      FOR TOP 20 AND NEXT 11 DXCATS

------------- DXCAT=215:Head Injury, including Intracranial Injury -------------

               HIGH RISK                  1984    1985   1984  1985  1985  EXPECTED
     STAGE      COMORB.    AGE   SEX      DISCH.  DISCH. MRATE MRATE MORT. 85 MORT.

          1       0        <70 ----       1476    1225  0.021 0.020   24    25.728
          1       0      70-79 MALE        857     693  0.040 0.036   25    27.494
          1       0      70-79 FEMALE     1144     901  0.010 0.018   16     9.451
          1       0      80+   MALE        666     555  0.054 0.061   34    30.000
          1       0      80+   FEMALE     1441    1372  0.029 0.019   26    39.989
          1       1        <70 ----         95      95  0.074 0.115   11     7.074
          1       1      70-79 MALE         76      62  0.184 0.134   11    15.105
          1       1      70-79 FEMALE       95     120  0.021 0.025    3     2.526
          1       1      80+   MALE         69      71  0.116 0.169   12     8.232
          1       1      80+   FEMALE      151     161  0.073 0.056    9    11.728
          1       2      ----  ----         31      33  0.323 0.242    8    10.645
          2       0        <80 ----        783     668  0.155 0.148   99   103.229
          2       0      80+   ----        481     431  0.249 0.179   77   107.526
          2       1      ----  ----        156     189  0.314 0.381   72    59.365
          2       2      ----  ----         22      14  0.682 0.429    6     9.545
          3       0      ----  ----        284     300  0.289 0.257   77    86.620
          3       1,2    ----  ----         66      62  0.545 0.532   33    33.818
   ---------                              ----    ----                ---  -------
   DXCAT                                  7893    6973                543  588.076


---------------------------- DXCAT=242:Alcoholism ----------------------------

             HIGH RISK                    1984     1985     1984    1985    1985   EXPECTED
   STAGE      COMORB.     AGE    SEX      DISCH.   DISCH.   MRATE   MRATE   MORT.  85 MORT.

        1       0        ----   ----        295      192    0.011   0.005      1      2.021
        1       1,2      ----   ----         11       10    0.000   0.000      0      0.000
        2       0          <70  ----       1773     1407    0.003   0.002      3      4.761
        2       0        70+    ----        652      518    0.008   0.017      9      3.972
        2       1,2      ----   ----         71       63    0.070   0.016      1      4.437
        3       0          <70  ----       7743     7322    0.029   0.030    218    213.712
        3       0        70-79  ----       3228     3047    0.044   0.043    132    134.982
        3       0        80+    ----        415      410    0.070   0.071     29     28.651
        3       1        ----   ----       1003     1111    0.175   0.182    202    194.951
        3       2        ----   ----         64       76    0.547   0.395     30     41.563
---------                                 -----    -----                    ---    -------
DXCAT                                     15245    14156                    625    629.049
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                ACTUAL, EXPECTED 85 MORTALITY BY STRATA                   10
                   FOR TOP 20 AND NEXT 11 DXCATS

----------------------- DXCAT=313:Aneurysm, abdominal -----------------------

        HIGH RISK                  1984    1985    1984   1985   1985  EXPECTED
 STAGE   COMORB.    AGE   SEX     DISCH.  DISCH.  MRATE  MRATE  MORT.  85 MORT.

     1      0       <70  ----      1482    1301   0.031  0.028     36     40.38
     1      0     70-79  ----      2386    2173   0.053  0.040     87    115.66
     1      0     80+    ----       823     731   0.119  0.088     64     87.04
     1      1       <70  ----       179     247   0.101  0.089     22     24.84
     1      1     70-79  ----       361     346   0.136  0.116     40     46.96
     1      1     80+    ----       132     128   0.288  0.219     28     36.85
     1      2     ----   ----        58      59   0.345  0.373     22     20.34
     2   ----     ----   ----         0       0   0.000  0.000      0      0.00
     3      0       <70  ----       369     306   0.285  0.363    111     87.07
     3      0     70-79  ----       698     532   0.391  0.382    203    208.07
     3      0     80+    ----       394     316   0.589  0.668    211    186.07
     3      1       <70  ----       100     116   0.440  0.543     63     51.04
     3      1     70-79  ----       179     225   0.626  0.627    141    140.78
     3      1     80+    ----        96     117   0.719  0.769     90     84.09
     3      2     ----   ----        87     109   0.701  0.706     77     76.43
---------                          ----    ----                  ----   -------
DXCAT                              7344    6706                  1195   1205.64

----------- DXCAT=815:Coronary Artery Disease---Acute Myocardial In -----------

           HIGH RISK                1984   1985   1984  1985  1985  EXPECTED
   STAGE    COMORB.   AGE  SEX     DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

       1       0       <70 MALE     14130  11195 0.012 0.009   101     134.7
       1       0       <70 FEMALE    8782   6791 0.009 0.006    44      58.0
       1       0     70-79 MALE     10001   7877 0.020 0.014   114     156.7
       1       0     70-79 FEMALE   10754   8364 0.014 0.011    94     119.8
       1       0     80+   MALE      2868   1972 0.045 0.033    65      89.4
       1       0     80+   FEMALE    5972   4133 0.034 0.025   102     140.5
       1       1       <70 ----      2389   2440 0.021 0.015    36      50.0
       1       1     70-79 ----      1741   1820 0.032 0.020    36      57.5
       1       1     80+   ----       821    562 0.066 0.056    37      43.5
       1       2     ----  ----       184    229 0.071 0.074    17      16.2
       2       0       <70 MALE     13515  13828 0.025 0.022   300     342.8
       2       0       <70 FEMALE    9274   9995 0.020 0.013   129     195.1
       2       0     70-79 MALE     13352  13912 0.045 0.036   496     620.0
       2       0     70-79 FEMALE   16296  17484 0.029 0.024   420     502.1
       2       0     80+   MALE      6570   6438 0.083 0.073   471     535.0
       2       0     80+   FEMALE   13013  13264 0.070 0.057   754     934.7
       2       1       <70 ----      2594   3526 0.045 0.033   115     157.7
       2       1     70-79 MALE      1319   1809 0.094 0.073   132     170.1
       2       1     70-79 FEMALE    1270   1807 0.060 0.049    89     108.1
       2       1     80+   MALE       674    775 0.190 0.134   104     147.2
       2       1     80+   FEMALE    1088   1366 0.117 0.118   161     159.5
       2       2       <70 ----       107    149 0.103 0.107    16      15.3
       2       2     70-79 MALE        60     89 0.217 0.236    21      19.3
       2       2     70-79 FEMALE      57     93 0.175 0.072     6      14.6
       2       2     80+   ----        77     99 0.247 0.202    20      24.4
       3       0       <70 MALE     13229  12212 0.141 0.142  1737    1717.0
       3       0       <70 FEMALE    6578   6207 0.160 0.156   966     994.6
       3       0     70-79 ----     28023  26703 0.219 0.208  5565    5835.5
       3       0     80+   MALE      6408   6302 0.330 0.325  2050    2081.0
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                    ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                         FOR TOP 20 AND NEXT 11 DXCATS

----------------------- DXCAT=710:Cancer of the Pancreas -----------------------

          HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
   STAGE   COMORB.   AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

       1      0       <70 MALE       313    227  0.229 0.220    50     51.95
       1      0       <70 FEMALE     332    214  0.178 0.173    37     38.03
       1      0     70-79 MALE       456    435  0.257 0.241   105    111.61
       1      0     70-79 FEMALE     592    464  0.211 0.185    86     97.97
       1      0     80+   MALE       212    162  0.330 0.370    60     53.49
       1      0     80+   FEMALE     450    361  0.296 0.263    95    106.70
       1      1       <70 ----        60     51  0.317 0.392    20     16.15
       1      1     70+   ----       190    199  0.474 0.462    92     94.26
       1      2     ----  ----        26     33  0.615 0.697    23     20.31
       2      0       <70 ----       348    268  0.256 0.280    75     68.54
       2      0     70-79 ----       482    466  0.315 0.311   145    146.95
       2      0     80+   ----       202    203  0.396 0.404    82     80.40
       2      1       <70 ----        28     33  0.321 0.364    12     10.61
       2      1     70+   ----        71    104  0.521 0.596    62     54.20
       2      2     ----  ----         7     10  0.571 0.500     5      5.71
       3      0       <70 MALE       141    139  0.411 0.388    54     57.18
       3      0       <70 FEMALE     137    114  0.292 0.333    38     33.28
       3      0     70+   ----       580    528  0.422 0.432   228    223.03
       3      1       <80 ----        86     89  0.488 0.461    41     43.47
       3      1     80+   ----        28     35  0.536 0.771    27     18.75
       3      2     ----  ----         7      8  0.571 0.750     6      4.57
---------                           ----   ----               ----   -------
 DXCAT                              4754   4143               1343   1337.16


----------- DXCAT=808:Tibial Iliac, Femoral or Popliteal Artery Dis ------------

          HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
   STAGE   COMORB.   AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

       1        0     <70 ----      3912   3423 0.016 0.015   51     56.000
       1        0   70-79 ----      4504   4258 0.033 0.030  126    139.917
       1        0   80+   MALE       711    681 0.076 0.078   53     51.722
       1        0   80+   FEMALE    1129   1166 0.094 0.105  122    109.474
       1        1     <70 ----       367    409 0.076 0.049   20     31.204
       1        1   70-79 ----       388    472 0.147 0.136   64     69.340
       1        1   80+   MALE        88     99 0.250 0.192   19     24.750
       1        1   80+   FEMALE     155    164 0.303 0.360   59     49.729
       1        2     <70 ----        27     36 0.407 0.306   11     14.667
       1        2   70+   ----        58     80 0.638 0.537   43     51.034
       2        0     <70 ----       747    805 0.037 0.026   21     30.174
       2        0   70-79 ----      1259   1262 0.048 0.052   66     61.145
       2        0   80+   ----      1027   1129 0.104 0.090  102    117.527
       2        1     <70 ----        88    116 0.091 0.164   19     10.545
       2        1   70+   ----       233    300 0.249 0.243   73     74.678
       2        2     <70 ----         3     11 0.000 0.000    0      0.000
       2        2   70+   ----        21     21 0.381 0.476   10      8.000
       3    ---     ----  ----        75     73 0.493 0.466   34     36.013
---------                          -----  -----              ---    -------
 DXCAT                             14792  14505              893    936.020
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                   ACTUAL, EXPECTED 85 MORTALITY BY STRATA                   4
                        FOR TOP 20 AND NEXT 11 DXCATS

------------ DXCAT=525:Bronchitis and Chronic Obstructive Pulmonary ------------

             HIGH RISK                  1984   1985   1984  1985  1985  EXPECTED
    STAGE     COMORB.   AGE   SEX       DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

         1       0        <70 ----       3783   2722 0.006 0.006    16     16.55
         1       0      70-79 MALE       1687   1221 0.022 0.024    29     26.78
         1       0      70-79 FEMALE     3299   2326 0.008 0.009    22     19.74
         1       0      80+   ----       3927   3084 0.030 0.036   111     92.67
         1       1        <70 MALE        274    265 0.011 0.015     4      2.90
         1       1        <70 FEMALE      260    262 0.031 0.046    12      8.06
         1       1      70-79 MALE        311    258 0.039 0.066    17      9.95
         1       1      70-79 FEMALE      428    410 0.023 0.029    12      9.58
         1       1      80+   MALE        224    200 0.094 0.090    18     18.75
         1       1      80+   FEMALE      488    467 0.051 0.054    25     23.92
         1       2        <80 ----        100    113 0.070 0.088    10      7.91
         1       2      80+   ----         40     58 0.175 0.190    11     10.15
         2       0        <70 ----       3573   2846 0.021 0.019    55     60.54
         2       0      70-79 MALE       2481   1892 0.038 0.038    71     71.68
         2       0      70-79 FEMALE     1550   1440 0.025 0.017    25     36.23
         2       0      80+   MALE        869    711 0.085 0.090    64     60.55
         2       0      80+   FEMALE      654    565 0.058 0.041    23     32.83
         2       1        <70 ----        552    506 0.072 0.059    30     36.67
         2       1      70-79 MALE        393    423 0.089 0.095    40     37.67
         2       1      70-79 FEMALE      252    265 0.060 0.038    10     15.77
         2       1      80+   MALE        164    135 0.116 0.178    24     15.64
         2       1      80+   FEMALE      120    126 0.042 0.078    10      5.33
         2       2      ----  ----        107    118 0.196 0.195    23     23.16
         3       0        <70 ----      17469  15190 0.047 0.048   729    717.42
         3       0      70-79 MALE      11652   9925 0.074 0.081   801    730.83
         3       0      70-79 FEMALE     7303   7144 0.063 0.062   446    449.01
         3       0      80+   MALE       4014   3418 0.112 0.110   377    381.48
         3       0      80+   FEMALE     2917   2683 0.079 0.105   283    210.63
         3       1        <70 ----       3184   3407 0.108 0.102   348    368.09
         3       1      70-79 MALE       2421   2600 0.152 0.156   412    395.21
         3       1      70-79 FEMALE     1489   1701 0.119 0.129   220    202.20
         3       1      80+   MALE        949    985 0.194 0.203   200    190.98
         3       1      80+   FEMALE      721    716 0.161 0.180   129    115.20
         3       2        <70 ----        266    324 0.226 0.235    76     73.08
         3       2      70-79 ----        325    423 0.268 0.229    97    113.23
         3       2      80+   ----        132    146 0.364 0.322    47     53.09
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 DXCAT                                  78398  69077               4827  4643.50
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                    ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                        FOR TOP 20 AND NEXT 11 DXCATS

------------------ DXCAT=290:Other Nervous System Conditions ------------------

        HIGH RISK                 1984     1985     1984    1985    1985    EXPECTED
  STAGE  COMORB.    AGE   SEX    DISCH.   DISCH.   MRATE   MRATE   MORT.   85 MORT.

  DXCAT                           23636    17814                     634    593.367


----------------------- DXCAT=504:Bacterial Pneumonia ------------------------

              HIGH RISK                 1984   1985   1984  1985   1985   EXPECTED
    STAGE      COMORB.    AGE   SEX     DISCH. DISCH. MRATE MRATE  MORT.  85 MORT.

        1         0        <70 MALE      5869   5665 0.051 0.042    239     291.5
        1         0        <70 FEMALE    4987   4940 0.029 0.023    113     145.6
        1         0      70-79 MALE      9252   9326 0.087 0.079    739     807.4
        1         0      70-79 FEMALE    8727   8733 0.052 0.050    434     458.3
        1         0      80+   MALE      8618   8780 0.161 0.159   1398    1412.1
        1         0      80+   FEMALE   11462  11686 0.144 0.132   1537    1680.2
        1         1        <70 MALE      1119   1458 0.140 0.143    208     204.6
        1         1        <70 FEMALE     845    975 0.107 0.130    127     103.8
        1         1      70-79 MALE      2023   2461 0.218 0.212    521     537.7
        1         1      70-79 FEMALE    1575   1967 0.157 0.136    267     309.7
        1         1      80+   MALE      2254   2543 0.282 0.290    738     717.5
        1         1      80+   FEMALE    2895   3325 0.251 0.244    812     833.8
        1         2        <70 MALE       119    142 0.286 0.352     50      40.6
        1         2        <70 FEMALE      70     87 0.157 0.276     24      13.7
        1         2      70-79 MALE       201    269 0.403 0.428    115     108.4
        1         2      70-79 FEMALE     135    190 0.326 0.274     52      61.9
        1         2      80+   ----       435    640 0.483 0.458    293     309.0
        2         0        <80 ----       522    748 0.069 0.063     47      51.6
        2         0      80+   ----       208    357 0.260 0.171     61      92.7
        2         1        <70 ----        49     68 0.224 0.265     18      15.3
        2         1      70-79 MALE        41     69 0.293 0.246     17      20.2
        2         1      70-79 FEMALE      25     50 0.080 0.060      3       4.0
        2         1      80+   MALE        35     53 0.514 0.377     20      27.3
        2         1      80+   FEMALE      37     62 0.270 0.242     15      16.8
        2         2      ----  ----        15     29 0.333 0.345     10       9.7
        3         0        <70 ----      1113   1513 0.242 0.254    385     365.7
        3         0      70-79 MALE       913   1382 0.359 0.348    481     496.5
        3         0      70-79 FEMALE     675    981 0.321 0.313    307     315.4
        3         0      80+   MALE       828   1044 0.530 0.487    508     553.5
        3         0      80+   FEMALE     848   1222 0.496 0.444    542     606.7
        3         1        <70 ----       429    656 0.382 0.345    226     250.8
        3         1      70-79 MALE       360    608 0.486 0.484    294     295.6
        3         1      70-79 FEMALE     232    418 0.431 0.400    167     180.2
        3         1      80+   MALE       343    487 0.676 0.593    289     329.4
        3         1      80+   FEMALE     363    555 0.573 0.542    301     318.0
        3         2        <80 ----       153    256 0.608 0.566    145     155.6
        3         2      80+   ----        94    184 0.766 0.712    131     140.9
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  DXCAT                                 67869  73929                11634  12281.5
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                  ACTUAL, EXPECTED 85 MORTALITY BY STRATA                       6
                      FOR TOP 20 AND NEXT 11 DXCATS

-------------------- DXCAT=590:Other Respiratory Conditions --------------------

            HIGH RISK                   1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.    AGE   SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

        1       2      70-79 ----        116    168 0.302 0.310    52     50.69
        1       2      80+   ----        105    134 0.443 0.463    62     59.42
        2       0        <70 MALE       1673   1299 0.053 0.039    51     69.10
        2       0        <70 FEMALE     1177    921 0.034 0.033    30     31.30
        2       0      70-79 ----       3707   3059 0.065 0.058   178    198.05
        2       0      80+   ----       2632   2159 0.137 0.129   279    295.30
        2       1        <70 ----        803    616 0.117 0.121    99     95.52
        2       1      70-79 ----       1202   1233 0.151 0.148   183    186.69
        2       1      80+   ----        929   1003 0.225 0.202   203    225.65
        2       2        <70 MALE         48     48 0.333 0.313    15     16.00
        2       2        <70 FEMALE       34     57 0.147 0.140     8      8.38
        2       2      70+   ----        213    255 0.277 0.329    84     70.63
        3       0        <70 ----        968    988 0.179 0.173   171    176.57
        3       0      70-79 MALE        636    628 0.308 0.280   176    193.53
        3       0      70-79 FEMALE      623    649 0.284 0.211   137    184.39
        3       0      80+   ----        895    924 0.476 0.436   403    439.80
        3       1        <70 MALE        219    269 0.511 0.398   107    137.57
        3       1        <70 FEMALE      174    208 0.379 0.365    76     78.90
        3       1      70-79 MALE        248    357 0.536 0.487   174    191.46
        3       1      70-79 FEMALE      180    326 0.428 0.448   146    139.46
        3       1      80+   MALE        118    193 0.695 0.684   132    134.12
        3       1      80+   FEMALE      236    314 0.572 0.564   177    179.62
        3       2        <70 ----         66    117 0.591 0.530    62     69.14
        3       2      70+   ----        150    259 0.700 0.680   176    181.30
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DXCAT                                  52070  49227               5058  5250.74


---------------- DXCAT=620:Vascular Insufficiency of Intestine ----------------

            HIGH RISK                   1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.    AGE   SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

        1       0      ----  ----        663    722 0.063 0.044    32    45.738
        1       1        <70 ----         22     33 0.045 0.061     2     1.500
        1       1      70-79 MALE         20     33 0.150 0.303    10     4.950
        1       1      70-79 FEMALE       18     29 0.056 0.103     3     1.611
        1       1      80+   ----         40     62 0.150 0.194    12     9.300
        1       2      ----  ----          9     22 0.778 0.364     8    17.111
        2       0        <70 MALE         97     72 0.175 0.167    12    12.619
        2       0        <70 FEMALE       85     78 0.318 0.269    21    24.776
        2       0      70-79 ----        306    310 0.363 0.303    94   112.451
        2       0      80+   MALE         87     87 0.471 0.368    32    41.000
        2       0      80+   FEMALE      193    210 0.539 0.529   111   113.161
        2       1        <80 ----        146    157 0.514 0.554    87    80.651
        2       1      80+   ----         87     96 0.793 0.719    69    76.138
        2       2      ----  ----         43     75 0.721 0.720    54    54.070
        3       0        <80 ----        113    130 0.425 0.423    55    55.221
        3       0      80+   ----         64     83 0.734 0.506    42    60.953
        3      1,2     ----  ----         77    133 0.675 0.797   106    89.818
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DXCAT                                   2070   2332                750   801.067
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              ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                 FOR TOP 20 AND NEXT 11 DXCATS

------------ DXCAT=527:Cancer of the Lung, Bronchus and Mediastinum ------------

           HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
   STAGE    COMORB.   AGE   SEX     DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

       1      0        <70 MALE      3337   2067 0.147 0.137   284    304.75
       1      0        <70 FEMALE    1477    996 0.116 0.111   111    115.99
       1      0      70-79 MALE      4107   2721 0.180 0.164   445    489.61
       1      0      70-79 FEMALE    1679   1257 0.142 0.111   139    178.18
       1      0      80+   MALE      1074    775 0.249 0.225   174    192.67
       1      0      80+   FEMALE     479    313 0.175 0.173    54     54.89
       1      1        <80 ----       974    903 0.308 0.297   268    278.13
       1      1      80+   ----       180    143 0.372 0.413    59     53.23
       1      2      ----  ----        73     87 0.589 0.586    51     51.25
       2      0        <70 MALE       835    899 0.164 0.160   144    147.50
       2      0        <70 FEMALE     368    377 0.111 0.143    54     42.00
       2      0      70-79 MALE      1131   1177 0.230 0.209   246    270.57
       2      0      70-79 FEMALE     413    523 0.189 0.184    96     98.77
       2      0      80+   MALE       390    418 0.310 0.287   120    129.69
       2      0      80+   FEMALE     186    164 0.231 0.220    36     37.91
       2      1        <70 ----       150    176 0.280 0.313    55     49.28
       2      1      70-79 MALE       153    160 0.451 0.425    68     72.16
       2      1      70-79 FEMALE      46     73 0.196 0.315    23     14.28
       2      1      80+   ----        81     91 0.519 0.451    41     47.19
       2      2      ----  ----        39     30 0.487 0.433    13     14.62
       3      0        <70 MALE      3589   3150 0.259 0.292   919    815.37
       3      0        <70 FEMALE    1615   1509 0.224 0.234   353    338.24
       3      0      70-79 MALE      3458   3403 0.306 0.315  1071   1041.17
       3      0      70-79 FEMALE    1556   1579 0.264 0.254   401    417.08
       3      0      80+   MALE       751    777 0.373 0.350   272    289.69
       3      0      80+   FEMALE     401    413 0.297 0.324   134    122.56
       3      1        <70 ----       659    795 0.398 0.419   333    316.07
       3      1      70+   MALE       444    463 0.475 0.443   205    220.03
       3      1      70+   FEMALE     175    247 0.394 0.397    98     97.39
       3      2      ----  ----        87    112 0.586 0.464    52     65.66
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DXCAT                               29907  25798              6319   6365.92


-------------------- DXCAT=590:Other Respiratory Conditions --------------------

           HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
   STAGE    COMORB.   AGE   SEX     DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

       1      0        <70 MALE      6378   5533 0.020 0.016    87    111.04
       1      0        <70 FEMALE    6164   5558 0.011 0.008    43     58.61
       1      0      70-79 MALE      5002   4419 0.052 0.055   241    228.81
       1      0      70-79 FEMALE    6523   6039 0.025 0.023   140    148.83
       1      0      80+   MALE      2349   2153 0.121 0.123   264    261.22
       1      0      80+   FEMALE    3898   3719 0.090 0.094   350    334.88
       1      1        <70 MALE      1006   1149 0.071 0.084    97     81.09
       1      1        <70 FEMALE     728    763 0.041 0.063    48     31.44
       1      1      70-79 MALE       890   1049 0.146 0.151   158    153.22
       1      1      70-79 FEMALE     800    960 0.089 0.100    96     85.20
       1      1      80+   MALE       445    599 0.261 0.264   158    156.14
       1      1      80+   FEMALE     629    770 0.213 0.223   172    164.04
       1      2        <70 ----        95    132 0.179 0.174    23     23.62
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                   ACTUAL, EXPECTED 85 MORTALITY BY STRATA                    8
                      FOR TOP 20 AND NEXT 11 DXCATS

----------------- DXCAT=690:Other Gastrointestinal Conditions -----------------

             HIGH RISK                  1984   1985   1984  1985  1985  EXPECTED
    STAGE     COMORB.    AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

         2       1        <70 MALE       917   1048 0.111 0.123   129   116.57
         2       1        <70 FEMALE     393   1059 0.103 0.092    97   109.10
         2       1      70-79 ----      2285   2611 0.171 0.159   414   446.78
         2       1      80+   MALE       657    806 0.279 0.274   221   224.50
         2       1      80+   FEMALE    1207   1439 0.239 0.244   351   344.55
         2       2        <70 MALE       103    157 0.330 0.344    54    51.83
         2       2        <70 FEMALE      94    166 0.202 0.265    44    33.55
         2       2      70-79 ----       277    436 0.354 0.362   158   154.25
         2       2      80+   ----       266    329 0.466 0.447   147   153.37
         3       0        <80 ----      1013    944 0.137 0.148   140   129.53
         3       0      80+   ----       274    290 0.234 0.276    80    67.74
         3       1      ----  ----       269    384 0.426 0.453   174   163.43
         3       2      ----  ----        73     77 0.685 0.636    49    52.74
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DXCAT                                  53574  48346               4019  4032.25


---------------------- DXCAT=704:Cirrhosis of the Liver ----------------------

             HIGH RISK                  1984   1985   1984  1985  1985  EXPECTED
    STAGE     COMORB.    AGE  SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

         1       0        <70 MALE       248    125  0.117 0.096   12    14.617
         1       0        <70 FEMALE     231    141  0.043 0.043    6     6.104
         1       0      70-79 MALE       194    114  0.144 0.105   12    16.454
         1       0      70-79 FEMALE     257    176  0.070 0.051    9    12.327
         1       0      80+   MALE        69     39  0.203 0.158    6     7.710
         1       0      80+   FEMALE      83     56  0.072 0.089    5     4.048
         1       1        <70 ----        72     46  0.139 0.152    7     6.389
         1       1      70-79 MALE        27     23  0.259 0.304    7     5.963
         1       1      70-79 FEMALE      32     37  0.188 0.081    3     6.938
         1       1      80+   ----        34     20  0.235 0.100    2     4.706
         1       2      ----  ----        21     27  0.619 0.481   13    16.714
         2       0        <80 ----       596    480  0.076 0.071   34    36.242
         2       0      80+   ----       123    106  0.122 0.132   14    12.927
         2       1,2    ----  ----       110    136  0.191 0.213   29    25.964
         3       0        <70 MALE       672    697  0.171 0.181  126   119.278
         3       0        <70 FEMALE     470    488  0.145 0.129   63    70.604
         3       0      70-79 MALE       405    412  0.240 0.238   98    98.677
         3       0      70-79 FEMALE     466    459  0.155 0.203   93    70.918
         3       0      80+   ----       229    295  0.249 0.271   80    73.428
         3       1        <70 ----       171    235  0.404 0.362   85    94.825
         3       1      70-79 MALE        75     95  0.427 0.484   46    40.533
         3       1      70-79 FEMALE      73     86  0.315 0.372   32    27.096
         3       1      80+   ----        48     46  0.375 0.435   20    17.250
         3       2      ----  ----        45     75  0.756 0.680   51    56.667
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DXCAT                                   4751   4413               653   846.377
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                ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                   FOR TOP 20 AND NEXT 11 DXCATS

------------------ DXCAT=624:Cancer of the Colon and Rectum ------------------

             HIGH RISK                1984    1985   1984  1985  1985   EXPECTED
    STAGE     COMORB.     AGE  SEX    DISCH.  DISCH. MRATE MRATE MORT.  85 MORT.

           1      0        <70 MALE     1578    1292 0.053 0.034    44     68.78
           1      0        <70 FEMALE   1404    1136 0.032 0.020    23     36.41
           1      0      70-79 MALE     2696    2464 0.057 0.045   111    141.66
           1      0      70-79 FEMALE   3130    2572 0.042 0.033    86    108.47
           1      0      80+   ----     3884    3452 0.088 0.073   251    303.07
           1      1        <70 ----      828     672 0.167 0.146    98    112.00
           1      1      70-79 MALE      769     650 0.221 0.177   115    143.69
           1      1      70-79 FEMALE    713     667 0.165 0.135    90    110.39
           1      1      80+   ----      859     833 0.268 0.216   180    223.04
           1      2        <70 ----      123     155 0.341 0.432    67     52.93
           1      2      70+   MALE       51      76 0.529 0.539    41     40.24
           1      2      70+   FEMALE     73      73 0.384 0.283    21     28.00
           2   ----      ----  ----        0       0 0.000 0.000     0      0.00
           3      0        <70 MALE      989     873 0.159 0.159   139    138.59
           3      0        <70 FEMALE    878     854 0.121 0.130   111    103.10
           3      0      70-79 MALE     1517    1499 0.192 0.161   241    287.55
           3      0      70-79 FEMALE   1627    1606 0.141 0.133   214    227.03
           3      0      80+   MALE      644     634 0.250 0.227   144    158.50
           3      0      80+   FEMALE    978     997 0.202 0.176   175    201.85
           3      1        <70 ----      203     221 0.325 0.312    69     71.85
           3      1      70-79 ----      352     450 0.298 0.259   119    137.22
           3      1      80+   MALE       79     123 0.418 0.390    48     51.38
           3      1      80+   FEMALE    142     142 0.303 0.317    45     43.00
           3      2      ----  ----       42      58 0.405 0.414    24     23.48
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DXCAT                                  23559   21509              2456   2812.21


----------------- DXCAT=690:Other Gastrointestinal Conditions -----------------

             HIGH RISK                1984    1985   1984  1985  1985   EXPECTED
    STAGE     COMORB.     AGE  SEX    DISCH.  DISCH. MRATE MRATE MORT.  85 MORT.

           1      0        <70 MALE     2322    1639 0.010 0.020    33     16.23
           1      0        <70 FEMALE   2797    2098 0.008 0.009    19     16.50
           1      0      70-79 MALE     2142    1654 0.024 0.030    50     40.15
           1      0      70-79 FEMALE   3962    2936 0.011 0.011    31     31.12
           1      0      80+   MALE     1113     796 0.058 0.050    40     46.49
           1      0      80+   FEMALE   2784    2088 0.041 0.039    82     86.25
           1      1        <70 MALE      439     453 0.116 0.099    45     52.63
           1      1        <70 FEMALE    440     457 0.073 0.066    30     33.24
           1      1      70-79 ----     1113    1097 0.083 0.108   119     90.68
           1      1      80+   MALE      196     233 0.214 0.193    45     49.93
           1      1      80+   FEMALE    405     436 0.109 0.123    54     47.59
           1      2        <70 ----       67      95 0.194 0.211    20     18.43
           1      2      70-79 ----      104     130 0.288 0.315    41     37.50
           1      2      80+   ----       44      78 0.500 0.410    32     39.00
           2      0        <70 MALE     3621    3146 0.034 0.031    96    106.00
           2      0        <70 FEMALE   3849    3423 0.022 0.021    72     74.70
           2      0      70-79 MALE     4677    3925 0.049 0.047   184    191.34
           2      0      70-79 FEMALE   6132    5526 0.035 0.034   188    194.65
           2      0      80+   MALE     2993    2722 0.108 0.099   270    292.84
           2      0      80+   FEMALE   6026    5666 0.092 0.090   510    519.02
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                        ACTUAL, EXPECTED 85 MORTALITY BY STRATA                      11
                         FOR TOP 20 AND NEXT 11 DXCATS

----------- DXCAT=815:Coronary Artery Disease---Acute Myocardial In ------------

          HIGH RISK                  1984   1985   1984  1985  1985   EXPECTED
  STAGE    COMORB.   AGE   SEX      DISCH. DISCH.  MRATE MRATE MORT.  85 MORT.

       3      0      80+   FEMALE    9728   9895 0.320 0.302  2992    3168.8
       3      1       <70 MALE       1396   1725 0.238 0.223   385     410.2
       3      1       <70 FEMALE      756    862 0.283 0.280   241     244.0
       3      1      70-79 ----      2839   3552 0.367 0.345  1224    1303.7
       3      1      80+   ----      1763   2137 0.454 0.474  1012     970.8
       3      2       <80 ----        297    458 0.549 0.517   237     251.4
       3      2      80+   ----       109    141 0.606 0.674    95      85.4
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 DXCAT                              208054 200306             20384  21874.5


---------------- DXCAT=821:Arrhythmias and Conduction Disorders ----------------

          HIGH RISK                  1984   1985   1984  1985  1985   EXPECTED
  STAGE    COMORB.   AGE   SEX      DISCH. DISCH.  MRATE MRATE MORT.  85 MORT.

       1      0       <70 MALE       3865   3163 0.012 0.011    34     39.28
       1      0       <70 FEMALE     3523   2897 0.006 0.002     7     17.27
       1      0      70-79 MALE      5734   4866 0.017 0.014    69     81.47
       1      0      70-79 FEMALE    7105   6133 0.013 0.010    64     76.82
       1      0      80+   MALE      3173   2751 0.036 0.033    90     99.71
       1      0      80+   FEMALE    5677   4911 0.025 0.025   122    121.97
       1      1       <70 MALE        498    585 0.038 0.050    29     22.32
       1      1       <70 FEMALE      321    353 0.019 0.031    11      6.60
       1      1      70-79 ----      1337   1430 0.065 0.063    90     93.05
       1      1      80+   ----       896   1003 0.103 0.100   100    102.99
       1      2       <80 ----         94    162 0.149 0.160    26     24.13
       1      2      80+   ----        40     51 0.300 0.255    13     15.30
       2      0       <70 MALE       1796   1816 0.026 0.023    41     46.51
       2      0       <70 FEMALE     1430   1389 0.012 0.009    13     16.51
       2      0      70-79 MALE      2678   2849 0.022 0.020    56     61.70
       2      0      70-79 FEMALE    3009   3196 0.013 0.013    40     40.36
       2      0      80+   MALE      1553   1747 0.036 0.037    65     63.00
       2      0      80+   FEMALE    2609   3052 0.023 0.020    60     70.19
       2      1       <70 ----        381    495 0.073 0.069    34     36.38
       2      1      70-79 ----       554    684 0.085 0.080    55     58.03
       2      1      80+   ----       363    523 0.104 0.109    57     54.62
       2      2      ----  ----        40     90 0.325 0.289    26     29.25
       3      0       <70 ----       5613   6055 0.066 0.063   382    401.29
       3      0      70-79 MALE      6206   6864 0.094 0.084   580    642.60
       3      0      70-79 FEMALE    6577   7240 0.069 0.064   455    501.97
       3      0      80+   MALE      4834   5302 0.135 0.132   702    715.12
       3      0      80+   FEMALE    9373  10103 0.115 0.109  1104   1166.27
       3      1       <70 ----        500    666 0.170 0.123    82    113.22
       3      1      70-79 MALE       531    735 0.217 0.208   153    159.18
       3      1      70-79 FEMALE     516    664 0.192 0.145    96    127.40
       3      1      80+   ----      1138   1465 0.243 0.251   368    355.31
       3      2      ----  ----       124    169 0.363 0.373    63     61.33
 ---------                          -----  -----              ----  -------
 DXCAT                              82108  83409              5097   5421.15
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                      ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                           FOR TOP 20 AND NEXT 11 DXCATS

--------------------- DXCAT=822:Diseases of Aortic Valve ---------------------

            HIGH RISK                      1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.   AGE   SEX         DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

         1       0       <80 ----         1598   1407  0.035 0.026   37    49.717
         1       0     80+   ----          344    276  0.081 0.076   21    22.465
         1       1     ----  ----          179    189  0.117 0.106   20    22.173
         1       2     ----  ----            9     12  0.222 0.250    3     2.667
         2   ----      ----  ----            0      0  0.000 0.000    0     0.000
         3       0       <70 ----          704    763  0.053 0.054   41    40.101
         3       0     70-79 MALE          831   1006  0.096 0.083   83    96.847
         3       0     70-79 FEMALE        902    957  0.070 0.057   55    66.841
         3       0     80+   MALE          624    703  0.135 0.114   80    94.635
         3       0     80+   FEMALE       1277   1482  0.097 0.093  138   143.906
         3       1     ----  ----          446    592  0.164 0.177  105    96.897
         3       2     ----  ----           13     33  0.308 0.515   17    10.154
---------                                 ----   ----               ---   -------
DXCAT                                     7027   7420               600   646.403


---------------------- DXCAT=829:Essential Hypertension ----------------------

            HIGH RISK                      1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.   AGE   SEX         DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

         1       0       <70 MALE         1390    814 0.009 0.006     5      7.03
         1       0       <70 FEMALE       2307   1342 0.004 0.002     3      5.24
         1       0     70-79 MALE         1020    624 0.013 0.010     6      7.95
         1       0     70-79 FEMALE       3035   1831 0.007 0.005    10     13.27
         1       0     80+   MALE          376    233 0.032 0.017     4      7.44
         1       0     80+   FEMALE       1606    977 0.016 0.011    11     15.82
         1       1     ----  ----          645    473 0.053 0.019     9     24.93
         1       2     ----  ----           27     13 0.074 0.077     1      0.96
         2       0       <70 ----         4903   4105 0.022 0.021    87     91.28
         2       0     70-79 MALE         2346   2050 0.050 0.051   104    102.24
         2       0     70-79 FEMALE       4315   3659 0.032 0.029   105    117.87
         2       0     80+   MALE         1164    999 0.108 0.094    94    108.00
         2       0     80+   FEMALE       3884   3429 0.060 0.054   218    204.82
         2       1       <70 ----          397    495 0.058 0.064    32     28.85
         2       1     70-79 ----          547    573 0.112 0.082    47     53.90
         2       1     80+   ----          351    358 0.191 0.140    50     68.34
         2       2     ----  ----           68     76 0.221 0.250    19     16.76
         3       0       <70 ----         7568   8028 0.052 0.052   414    415.83
         3       0     70-79 MALE         5167   5719 0.069 0.068   388    397.35
         3       0     70-79 FEMALE       8120   8380 0.061 0.060   532    538.05
         3       0     80+   ----         9347   9293 0.113 0.110  1018   1053.21
         3       1       <70 ----          584    596 0.147 0.141    97    101.02
         3       1     70-79 ----          986   1130 0.193 0.196   221    218.09
         3       1     80+   ----          528    628 0.229 0.250   157    143.92
         3       2     ----  ----           50     65 0.380 0.400    26     24.70
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DXCAT                                    59651  56484              3658   3776.87
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                ACTUAL, EXPECTED 85 MORTALITY BY STRATA                        14
                    FOR TOP 20 AND NEXT 11 DXCATS

-------------- DXCAT=901:Urinary Tract Infection (Other than Tbc) -------------

            HIGH RISK                   1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.    AGE   SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

         2       0      70-79 FEMALE    1583    1561 0.015 0.007    11     22.68
         2       0      80+   MALE       470     453 0.047 0.044    20     21.20
         2       0      80+   FEMALE    1314    1301 0.024 0.032    41     31.68
         2       1        <70 ----       181     247 0.022 0.032     8      5.46
         2       1      70+   ----       513     598 0.082 0.075    45     48.96
         2       2        <80 ----        24      30 0.083 0.067     2      2.50
         2       2      80+   ----        18      20 0.333 0.300     6      6.67
         3       0        <70 ----       927    1034 0.078 0.073    75     80.31
         3       0      70-79 MALE       743     880 0.145 0.135   119    127.91
         3       0      70-79 FEMALE    1032    1260 0.090 0.098   123    113.55
         3       0      80+   ----      2439    3049 0.191 0.196   599    583.80
         3       1        <70 ----       200     321 0.125 0.190    61     40.13
         3       1      70-79 MALE       201     292 0.303 0.247    72     88.62
         3       1      70-79 FEMALE     275     368 0.196 0.190    70     72.26
         3       1      80+   MALE       224     348 0.362 0.382   133    125.84
         3       1      80+   FEMALE     428     553 0.327 0.311   172    180.89
         3       2      ----  ----       126     188 0.429 0.436    82     80.57
  ---------                            -----  -----               ----   -------
  DXCAT                                32965  31860               2602   2424.41


----------------------- DXCAT=902:Acute Renal Failure -------------------------

            HIGH RISK                   1984   1985   1984  1985  1985  EXPECTED
   STAGE     COMORB.    AGE   SEX      DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

         1       0        <70 ----      2899    1818 0.069 0.063   115    124.80
         1       0      70-79 ----      1681    1258 0.208 0.202   260    267.41
         1       0      80+   ----      1524    1363 0.348 0.342   466    474.90
         1       1        <70 ----       413     375 0.218 0.272   102     81.72
         1       1      70-79 MALE       278     290 0.414 0.445   129    119.96
         1       1      70-79 FEMALE     273     252 0.366 0.345    87     92.31
         1       1      80+   ----       534     567 0.498 0.519   294    282.44
         1       2        <70 ----        46      49 0.543 0.490    24     26.63
         1       2      70+   ----       179     178 0.676 0.669   119    120.32
         2       0        <70 ----      1130    1023 0.035 0.024    25     36.21
         2       0      70-79 ----       726     729 0.084 0.086    63     61.25
         2       0      80+   ----       364     360 0.266 0.211    76     95.93
         2       1        <70 ----       136     150 0.081 0.127    19     12.13
         2       1      70-79 ----       156     182 0.147 0.220    40     26.83
         2       1      80+   ----        92     111 0.326 0.351    39     36.20
         2       2      ----  ----        17      20 0.529 0.300     6     10.59
         3       0        <70 ----       439     479 0.082 0.069    33     39.28
         3       0      70-79 ----       296     383 0.199 0.154    59     76.34
         3       0      80+   ----       193     242 0.326 0.339    92     78.99
         3       1        <70 ----        82     136 0.195 0.243    33     26.54
         3       1      70-79 ----       102     150 0.333 0.347    52     50.00
         3       1      80+   ----        76      77 0.461 0.636    49     35.46
         3       2      ----  ----        17      14 0.588 0.500     7      8.24
  ---------                            -----  -----               ----   -------
  DXCAT                                11653  10236               2179   2194.49
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                ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                    FOR TOP 20 AND NEXT 11 DXCATS

------------------ DXCAT=890:Other Cardiovascular Conditions ------------------

           HIGH RISK                1984   1985   1984  1985  1985  EXPECTED
   STAGE    COMORB.   AGE   SEX    DISCH. DISCH.  MRATE MRATE MORT. 85 MORT.

       1       0      <70 MALE      5322   4131 0.016 0.014    56    64.43
       1       0      <70 FEMALE    4244   3426 0.009 0.010    34    32.29
       1       0    70-79 MALE      5846   4675 0.025 0.016    76   118.35
       1       0    70-79 FEMALE    7282   5907 0.016 0.013    78    91.66
       1       0    80+   MALE      2814   2231 0.058 0.032    73   131.89
       1       0    80+   FEMALE    5902   4566 0.032 0.025   112   144.67
       1       1      <80 ----      2115   2193 0.067 0.071   155   147.24
       1       1    80+   MALE       294    288 0.116 0.111    32    33.31
       1       1    80+   FEMALE     532    509 0.109 0.057    29    55.49
       1       2      <70 ----        50     60 0.160 0.200    12     9.60
       1       2    70-79 ----        67     75 0.090 0.093     7     6.72
       1       2    80+   ----        35     42 0.371 0.238    10    15.60
       2       0      <70 ----      9028   6573 0.061 0.049   323   401.17
       2       0    70-79 MALE      7456   5512 0.093 0.083   458   510.84
       2       0    70-79 FEMALE    8700   6581 0.070 0.059   389   459.91
       2       0    80+   MALE      6004   4714 0.142 0.136   640   670.51
       2       0    80+   FEMALE   11423   8679 0.122 0.118  1023  1059.90
       2       1      <70 MALE       731    803 0.142 0.134   108   114.24
       2       1      <70 FEMALE     680    702 0.097 0.111    78    68.14
       2       1    70-79 MALE      1074   1058 0.224 0.194   205   237.41
       2       1    70-79 FEMALE     952   1086 0.173 0.177   192   188.22
       2       1    80+   ----      2069   2252 0.291 0.278   625   656.33
       2       2      <70 ----        64    136 0.226 0.287    39    30.76
       2       2    70-79 ----       163    194 0.368 0.351    68    71.41
       2       2    80+   ----       126    199 0.500 0.462    92    99.50
       3       0      <70 ----       977    669 0.686 0.665   445   458.78
       3       0    70-79 ----      1607   1178 0.743 0.738   869   875.25
       3       0    80+   ----      1576   1250 0.841 0.839  1049  1050.92
       3       1      <70 ----       308    286 0.744 0.720   206   212.64
       3       1    70-79 ----       470    418 0.840 0.837   350   351.30
       3       1    80+   ----       399    347 0.894 0.905   314   310.38
       3       2    ----  ----       131    143 0.832 0.902   129   118.98
  ---------                        -----  -----              ----  -------
  DXCAT                            88460  70943              8276  8797.85


-------------- DXCAT=901:Urinary Tract Infection (Other than Tbc) --------------

           HIGH RISK                1984   1985   1984  1985  1985  EXPECTED
   STAGE    COMORB.   AGE   SEX    DISCH. DISCH.  MRATE MRATE MORT. 85 MORT.

       1       0      <70 MALE      1952   1574 0.005 0.015    24     7.26
       1       0      <70 FEMALE    1815   1387 0.012 0.018    25    16.81
       1       0    70-79 ----      6036   4796 0.021 0.031   149   100.91
       1       0    80+   ----      7507   6483 0.054 0.061   398   353.21
       1       1      <70 ----       360    395 0.053 0.073    29    20.79
       1       1    70-79 MALE       327    376 0.138 0.096    36    51.74
       1       1    70-79 FEMALE     394    415 0.081 0.087    36    33.71
       1       1    80+   ----      1067   1161 0.116 0.159   185   134.92
       1       2    ----  ----       123    208 0.236 0.236    49    49.04
       2       0      <70 ----      2008   1828 0.006 0.009    16    11.83
       2       0    70-79 MALE       658    734 0.015 0.022    16    11.16
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               ACTUAL, EXPECTED 85 MORTALITY BY STRATA                     16
                  FOR TOP 20 AND NEXT 11 DXCATS

------------------------ DXCAT=1214:Diabetes Mellitus ------------------------

           HIGH RISK                    1984   1985   1984  1985  1985  EXPECTED
    STAGE   COMORB.    AGE  SEX        DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

        1      0        <70 ----        1724    263 0.009 0.000     0      2.44
        1      0      70-79 MALE         621    101 0.024 0.010     1      2.44
        1      0      70-79 FEMALE      1194    157 0.011 0.006     1      1.71
        1      0      80+   ----         777    111 0.036 0.009     1      4.00
        1      1        <80 ----         301     63 0.030 0.016     1      1.88
        1      1      80+   ----          96     15 0.104 0.063     1      1.67
        1      2      ----  ----          13      7 0.154 0.000     0      1.08
        2      0        <70 MALE        5763   5172 0.013 0.010    50     68.21
        2      0        <70 FEMALE      7252   6325 0.009 0.009    56     54.95
        2      0      70-79 MALE        4690   4282 0.026 0.025   105    111.39
        2      0      70-79 FEMALE      8168   7215 0.017 0.020   145    120.72
        2      0      80+   MALE        1690   1713 0.049 0.050    96     94.13
        2      0      80+   FEMALE      3997   3573 0.039 0.039   141    138.56
        2      1        <70 ----        1033   1144 0.046 0.051    58     53.16
        2      1      70-79 MALE         495    533 0.069 0.113    60     36.61
        2      1      70-79 FEMALE       928    866 0.065 0.048    42     56.48
        2      1      80+   ----         716    743 0.119 0.101    75     88.21
        2      2        <70 ----          44     57 0.114 0.105     6      6.48
        2      2      70+   ----         107    125 0.308 0.160    20     38.55
        3      0        <70 ----        3191   3440 0.061 0.059   203    211.29
        3      0      70-79 MALE         787    922 0.149 0.155   143    137.07
        3      0      70-79 FEMALE      1471   1544 0.116 0.104   161    178.44
        3      0      80+   ----        1403   1624 0.222 0.214   348    359.99
        3      1        <70 ----         639    847 0.158 0.163   138    134.09
        3      1      70-79 MALE         185    255 0.297 0.322    82     75.81
        3      1      70-79 FEMALE       325    352 0.215 0.233    82     75.82
        3      1      80+   ----         343    393 0.397 0.379   149    155.83
        3      2        <80 ----          87    107 0.414 0.449    48     44.28
        3      2      80+   ----          35     47 0.657 0.681    32     30.89
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 DXCAT                                  47994  41997               2235   2276.13

------------ DXCAT=1290:Other Endocrine and Metabolic Conditions -------------

           HIGH RISK                    1984   1985   1984  1985  1985  EXPECTED
    STAGE   COMORB.    AGE  SEX        DISCH. DISCH. MRATE MRATE MORT. 85 MORT.

        1      0        <70 MALE        2183   1919 0.041 0.048    93     79.12
        1      0        <70 FEMALE      3035   3140 0.024 0.023    71     74.49
        1      0      70-79 MALE        3007   3054 0.074 0.084   258    226.49
        1      0      70-79 FEMALE      6014   6194 0.039 0.040   249    239.97
        1      0      80+   MALE        3042   3444 0.131 0.140   483    450.60
        1      0      80+   FEMALE      7989   8531 0.086 0.089   758    731.47
        1      1        <70 MALE         769   1032 0.160 0.208   215    165.07
        1      1        <70 FEMALE       780   1010 0.123 0.151   153    124.31
        1      1      70-79 MALE        1002   1453 0.210 0.244   355    304.52
        1      1      70-79 FEMALE      1252   1713 0.153 0.165   283    262.70
        1      1      80+   MALE         809   1179 0.288 0.312   368    339.56
        1      1      80+   FEMALE      1508   1987 0.197 0.212   422    391.34
        1      2        <70 ----         218    326 0.234 0.252    82     76.27
        1      2      70-79 MALE         127    229 0.339 0.441   101     77.54
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            ACTUAL, EXPECTED 85 MORTALITY BY STRATA
                 FOR TOP 20 AND NEXT 11 DXCATS

-------------- DXCAT=903:Cancer at Genitourinary Sites - Bladder ---------------

            HIGH RISK                  1984   1985   1984  1985  1985  EXPECTED
    STAGE    COMORB.    AGE  SEX      DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

        1      0        <70 MALE       2257   1803 0.011 0.009   16     19.172
        1      0        <70 FEMALE      662    550 0.021 0.015    8     11.631
        1      0      70-79 ----       5501   4488 0.016 0.016   72     73.427
        1      0      80+   ----       3392   2997 0.034 0.031   92    103.375
        1      1        <80 ----        502    518 0.080 0.075   39     41.275
        1      1      80+   ----        256    255 0.160 0.122   31     40.840
        1      2      ----  ----         44     47 0.295 0.255   12     13.886
        2      0      ----  ----        340    343 0.091 0.102   35     31.274
        2      1        <80 ----         30     31 0.100 0.129    4      3.100
        2      1      80+   ----         11      9 0.364 0.444    4      3.273
        2      2      ----  ----          3      4 0.333 0.500    2      1.333
        3      0        <80 ----        631    630 0.208 0.206  130    130.792
        3      0      80+   ----        200    231 0.320 0.286   66     73.920
        3      1,2      <70 ----         44     34 0.295 0.353   12     10.045
        3      1,2    70-79 MALE         74     81 0.338 0.284   23     27.365
        3      1,2    70-79 FEMALE       13     24 0.462 0.542   13     11.077
        3      1,2    80+   ----         57     46 0.404 0.457   21     18.561
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   DXCAT                              14017  12091               580    614.347


--------------------- DXCAT=1001:Carcinoma of the Prostate ---------------------

          HIGH RISK                   1984    1985    1984    1985   1985   EXPECTED
  STAGE    COMORB.    AGE    SEX     DISCH.  DISCH.   MRATE   MRATE  MORT.  85 MORT.

      1      0         <70   ----     3018    2578    0.015   0.010    26      39.29
      1      0       70-79   ----     6717    5639    0.023   0.016    91     127.61
      1      0       80+     ----     3569    3132    0.042   0.026    81     132.51
      1      1         <80   ----      408     448    0.113   0.060    27      50.51
      1      1       80+     ----      243     193    0.144   0.104    20      27.80
      1      2       ----    ----       26      22    0.077   0.273     6       1.69
      2      0         <80   ----      339     298    0.015   0.037    11       4.40
      2      0       80+     ----      148     151    0.054   0.066    10       8.16
      2      1,2     ----    ----       26      22    0.115   0.136     3       2.54
      3      0         <70   ----     1513    1427    0.113   0.119   170     161.28
      3      0       70-79   ----     3491    3136    0.147   0.138   432     460.83
      3      0       80+     ----     1863    1811    0.199   0.182   330     359.67
      3      1       ----    ----      632     623    0.301   0.289   180     187.29
      3      2       ----    ----       27      26    0.444   0.423    11      11.56
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DXCAT                                22020   19506                   1398   1575.14
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                    ACTUAL, EXPECTED 85 MORTALITY BY STRATA             17
                     FOR TOP 20 AND NEXT 11 DXCATS

------------- DXCAT=1290:Other Endocrine and Metabolic Conditions -------------

           HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
  STAGE     COMORB.   AGE   SEX     DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

         1      2    70-79 FEMALE     121     205 0.264 0.273    56     54.21
         1      2    80+   ----       224     456 0.420 0.454   207    191.36
         2      0      <80 ----       434     501 0.106 0.104    52     53.10
         2      0    80+   ----       190     208 0.221 0.236    49     45.98
         2      1      <70 ----        62     108 0.207 0.167    18     22.39
         2      1    70-79 ----        78     107 0.359 0.299    32     38.41
         2      1    80+   ----        70     100 0.443 0.440    44     44.29
         2      2      <80 ----        35      43 0.457 0.558    24     19.66
         2      2    80+   ----        10      26 0.900 0.731    19     23.40
         3      0      <70 ----       482     526 0.021 0.027    14     10.91
         3      0    70-79 MALE       231     228 0.043 0.053    12      9.87
         3      0    70-79 FEMALE     434     414 0.025 0.027    11     10.49
         3      0    80+   ----       463     473 0.058 0.059    28     27.58
         3      1      <70 ----       101     141 0.099 0.092    13     13.96
         3      1    70-79 ----       145     140 0.083 0.129    18     11.59
         3      1    80+   MALE        28      35 0.214 0.257     9      7.50
         3      1    80+   FEMALE      67      65 0.075 0.092     6      4.85
         3      2    ----  ----        35      67 0.200 0.284    19     13.40
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DXCAT                               34965  39054               4522   4146.38


-------------------- DXCAT=1305:Acute Granulocytic Leukemia --------------------

           HIGH RISK                 1984   1985   1984  1985  1985  EXPECTED
  STAGE     COMORB.   AGE   SEX     DISCH. DISCH. MRATE MRATE MORT.  85 MORT.

         1      0      <80 ----       409     254 0.242 0.244    62    61.482
         1      0    80+   ----       128     117 0.305 0.368    43    35.648
         1      1      <70 ----        34      22 0.412 0.455    10     9.059
         1      1    70-79 MALE        14      26 0.500 0.731    19    13.000
         1      1    70-79 FEMALE      11      19 0.364 0.421     8     6.909
         1      1    80+   ----        19      26 0.421 0.500    13    10.947
         1      2    ----  ----        16      13 0.625 0.692     9     8.125
         2      0      <70 ----       126     127 0.135 0.165    21    17.135
         2      0    70-79 ----       232     271 0.241 0.199    54    65.414
         2      0    80+   ----       160     174 0.275 0.287    50    47.850
         2      1    ----  ----       119     153 0.353 0.386    59    54.000
         3      0      <70 ----        55      61 0.291 0.246    15    17.745
         3      0    70+   ----        94     100 0.479 0.510    51    47.872
         3      1      <70 ----        19      10 0.632 0.400     4     6.316
         3      1    70-79 MALE        14      11 0.286 0.455     5     3.143
         3      1    70-79 FEMALE       4      18 0.250 0.778    14     4.500
         3      1    80+   ----         8      10 0.875 0.600     6     8.750
         3      2    ----  ----         4       6 0.500 0.667     4     3.000
---------                            ----   ----                ---   -------
DXCAT                                1466   1418                447   420.896
```

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--------------------- DXCAT=1690:Other Bacterial Diseases ----------------------

         HIGH RISK                    1984   1985   1984  1985  1985  EXPECTED
  STAGE   COMORB.    AGE   SEX       DISCH. DISCH.  MRATE MRATE MORT. 85 MORT.

       1      0       <70  ----       394    282  0.010 0.007     2     2.86
       1      0     70-79  ----       514    373  0.033 0.032    12    12.34
       1      0     80+    ----       414    318  0.060 0.060    19    19.20
       1      1     ----   ----       176    164  0.096 0.116    19    15.66
       1      2     ----   ----        10     15  0.400 0.133     2     6.00
       2  ----      ----   ----         0      0  0.000 0.000     0     0.00
       3      0       <70  ----       670    567  0.119 0.116    66    67.70
       3      0     70-79  ----      1062    858  0.208 0.177   152   178.55
       3      0     80+    ----      1171   1032  0.307 0.271   280   317.27
       3      1       <70  ----       370    435  0.300 0.287   125   130.50
       3      1     70-79  ----       426    500  0.378 0.376   188   188.97
       3      1     80+    MALE       158    188  0.418 0.521    98    78.53
       3      1     80+    FEMALE     252    255  0.548 0.553   141   135.64
       3      2       <80  ----       201    284  0.557 0.602   171   158.25
       3      2     80+    MALE        37     60  0.676 0.600    36    40.54
       3      2     80+    FEMALE      67     99  0.761 0.758    75    75.36
---------                            ----   ----               ----  -------
 DXCAT                               5924   5430               1386  1431.37


--------------------------- DXCAT=1691:Other Neoplasms -------------------------

         HIGH RISK                    1984   1985   1984  1985  1985  EXPECTED
  STAGE   COMORB.    AGE   SEX       DISCH. DISCH.  MRATE MRATE MORT. 85 MORT.

       1       0      <70  MALE      2367   1482 0.063 0.059    87    93.29
       1       0      <70  FEMALE    2370   1561 0.042 0.038    60    65.21
       1       0    70-79  MALE      2772   1877 0.093 0.088   166   175.38
       1       0    70-79  FEMALE    3169   2218 0.059 0.060   134   131.58
       1       0    80+    ----      2776   1877 0.121 0.133   249   227.86
       1       1      <70  ----       862    698 0.210 0.215   150   146.56
       1       1    70-79  ----      1355   1124 0.260 0.241   271   291.99
       1       1    80+    ----       661    603 0.303 0.317   191   182.45
       1       2    ----   ----       261    269 0.521 0.528   142   140.17
       2     ---    ----   ----         0      0 0.000 0.000     0     0.00
       3     ---    ----   ----         3      2 0.625 0.000     0     1.88
---------                           -----  -----               ----  -------
 DXCAT                              16601  11712               1450  1456.37


--------------------- DXCAT=1693:Other General Conditions ----------------------

         HIGH RISK                    1984   1985   1984  1985  1985  EXPECTED
  STAGE   COMORB.    AGE   SEX       DISCH. DISCH.  MRATE MRATE MORT. 85 MORT.

       1      0       <70  MALE      4196   2867 0.026 0.015    42    74.48
       1      0       <70  FEMALE    4875   4062 0.017 0.008    32    70.82
       1      0     70-79  MALE      4319   3102 0.048 0.025    79   147.95
       1      0     70-79  FEMALE    5793   4865 0.031 0.015    71   148.65
       1      0     80+    MALE      2168   1375 0.089 0.049    68   121.77
       1      0     80+    FEMALE    3862   2749 0.073 0.048   133   200.02
       1      1       <70  ----      6201   8133 0.024 0.023   185   192.80
       1      1     70-79  MALE      2586   3663 0.049 0.041   149   179.89
       1      1     70-79  FEMALE    3127   4102 0.023 0.025   103    93.14
```

SELECTING TRACERS

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PROSPECTIVE PAYMENT SYSTEM EVALUATION STUDIES--
Selection of Tracers in Studies of PPS and Service Utilization

Working Paper

Cary Sennett, MD

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Selection of Tracers in Studies of PPS and Service Utilization

Cary Sennett, MD

In 1973, Kessner et al. described a method for using so-called "tracer" conditions in evaluations of the quality of health care services (Kessner et al., 1973). In that work, the authors outline criteria intended to "give a rational and uniform basis for selecting the tracers." In particular, they suggest that conditions appropriate for use as tracers meet the following conditions: that (1) they have a definite functional impact; (2) they be easy to diagnose; (3) they be prevalent; (4) they be sensitive to the quantity or quality (or both) of medical services received by the patient; (5) they have well defined techniques of medical management; and (6) their epidemiology be well understood.

Since their work, "tracer methodology" has been used in a large number of studies to evaluate health services, ranging from quality of care to medical information systems technology. Of particular interest to us, tracer methods have been used in a number of studies on variation in health services resource use. A review of selected recent journals, for example, revealed tracer-based work by Nutting et al. (1981), Payne et al. (1984), Fernow et al. (1981), and Arnould et al. (1984) on the efficiency of health services delivery; by Cannoodt and Knickman (1984) on length of hospital stay; by Scitovsky (1985) on the cost of illness; and by Gold (1981) on physician practice patterns. In addition, Hughes (1985) has recently reviewed a number of tracer-based studies of long-term care service delivery.

Thus it is clear that tracer methods have been used in areas of investigation much different from the area of quality of care evaluation for which Kessner et al. outlined the methodology. In many of these areas, the rationale for the choice of tracer conditions is unclear. Some authors (e.g., Nutting et al.) cite Kessner's work; others (e.g., Arnould et al. and Gold) suggest criteria for selection of tracers which are dominated by criteria like those Kessner described; still others list criteria which are reasonable without further elaboration (e.g., Payne et al. and Cannoodt and Knickman); still others offer no rationale (e.g., Fernow et al.). Given the broad range of topic and the divergence of topic from that for which Kessner originally outlined criteria for tracer selection, it is unclear that the criteria of Kessner can be so broadly applied in developing tracer conditions in health services research.

In order to begin our tracer-based work on changes in the delivery of health services in response to Medicare's new DRG-based prospective payment system, we attempted to establish what are "rational and uniform" criteria for the choice of tracer conditions. We reviewed the literature of the past five years in five of the major journals reporting research in health services (Medical Care, Health Services Research, Inquiry, Health Care Financing Review, and Journal of Health Economics). In that review, we were unable to find any papers relating to the choice of tracers for studies of resource use in health care. The absence of such a study motivates the current work, which is an attempt to establish rational criteria for the selection of tracer diagnoses for studies in health services research, and to develop an algorithm for the selection of optimal tracers under different experimental conditions.

We consider the utilization of the various health care services available to be controlled by the physician, who allocates them according to his or her economic preferences. The physician's preferences are determined by a vector of parameters, including but not limited to the patient's preferences, the patient's type and severity of illness ("clinical state"), the services available, their relative "prices" to the physician, their relative returns, and prevailing practice patterns. We model the utilization of health care services over any episode as the solution to **[OR: as proceeding along]** a decision tree, wherein the decision maker is the physician, each node is an allocative decision,[1] and each limb represents the allocation of the requisite quantity of services of the type specified for care of the episode under consideration until the next allocative decision node.

Consider the simple two-limb tree below in which the physician must choose between the utilization of inpatient or alternative (that is, outpatient) services in order to manage a patient with a given problem. At the first node, the patient presents to the physician for evaluation, and the physician must decide whether to admit the patient to the hospital for his or her entire care (committing x_1 units of inpatient care) or whether to treat the patient as an outpatient (committing x_2 units of outpatient care). Both x_1 and x_2 can be vectors of services. Depending upon a large number of factors (those that govern the physician's allocative decision-making), there is some probability that the physician will choose to admit the patient to the hospital, and some probability that he or she will choose not to do so. The expected utilization of hospital services is the product of the former probability and x_1; the expected utilization of outpatient services is the product of the latter probability and x_2.

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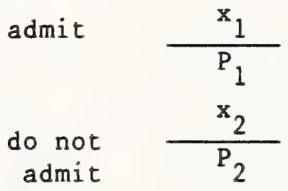
[1] The decision tree is modeled as a series of choices, each occurring probabilistically. It seems unlikely that the physician's decision-making process is truly stochastic; in fact, we have suggested that the decision-making process is explicitly non-stochastic, depending upon a vector of parameters which determine physician preference. It is reasonable to assume, however, that a stochastic model is a legitimate representation of the process of care insofar as there are stochastic elements with respect to patient choice of physician, and there are differences among physicians with respect to preferences for care. That is, for any given episode of illness, it is reasonable to consider the physician's choice as a chance node, where the stochastic element derives from variation in physician preferences (conditional upon the vector of determinants), and chance with respect to patient choice of physician. While it is probably true that the latter is not random, it is hardly restrictive to assert that patient choice is not strictly governed by physician preferences. In this case, it seems legitimate to regard allocative decision making over any (or all) episode(s) of illness as a series of chance events. Thus, the expected allocation of services is a (linear) function of the probabilities of a series of events, which are dependent upon those parameters governing physician decision-making.



expected use of services =
P_1x_1 (inpatient services) +
P_2x_2 (inpatient services)

Figure 1: A Simple Two-Limb Scheme

This model is gratifyingly simple, but disconcertingly simplistic. It can be improved by generalizing each node to include multiple branches (implying multiple alternatives to inpatient care), and by extending each limb to include many decisions (implying repeated evaluation during the episode, with services allocated at each node for use during the interval between that evaluation and subsequent evaluation). This more general model is presented in Figure 2. At node "a", the patient presents for evaluation, and the physician chooses from service bundles x_{1a} through x_{na} in order to provide necessary care for the episode between that evaluation and the next. The choice of service bundle x_{na} occurs with probability P_{ma}, which depends upon the vector of physician preference and patient state parameters already named. At some point in the episode, reevaluation occurs; at that time, additional services are disbursed. The choice of service type may be different, reflecting changes in patient state; the magnitude of each service bundle will likely change as well, reflecting new or different needs. The process of reevaluation and reallocation is continued as long as the episode of illness requires care (see Figure 2).

The tree in Figure 2 is of use to us because it suggests that the expected utilization of services of any type (inpatient or outpatient, laboratory or office time) will be the sum, over all decisions, of the products of the quantity of such services allocated at each decision node and the probability of allocating those services at that decision node. If we are interested in the expected utilization of inpatient hospital services for an episode "k" of illness "i", then we need "only" solve the decision tree for episode k. If we are interested in the change in hospital utilization for all patients with illness "i" that follows some shock to the health care system, we need "only" compare the expected utilization for that group, before and after the shock. It is clear from consideration of the figure above, however, that calculation of that expected utilization rapidly becomes complex.

A Simple Model

We introduce the following simple model of the sort described above to permit formal analysis of the process of resource allocation. The model motivates the development of a framework for the selection of tracer conditions for use in studies of the impact of PPS on this process. Despite its simplicity, we feel that the model is fundamentally accurate with respect to the critical processes involved in physician-determined allocation of health care services: namely, the critical decision whether or not to admit a patient to the hospital, and whether to substitute alternative (outpatient based) services for inpatient services at some point in the episode.

The model is outlined in Figure 3. The process of allocation of services begins with the presentation of a patient to the physician. At that point, the physician elects to admit the patient to the hospital or to employ other services. If the patient is admitted to the hospital x_{1a} inpatient services are committed.[2] The probability of admission to the hospital (P_{1a}) is a function of physician preferences (which will in part reflect incentives which may evolve from PPS), and the severity of illness (clinical state). For any episode of illness, the expected number of hospitalizations is P_{1a}; for all episodes of illness (for any condition) the expected number of hospitalizations is as shown in Figure 3 below.

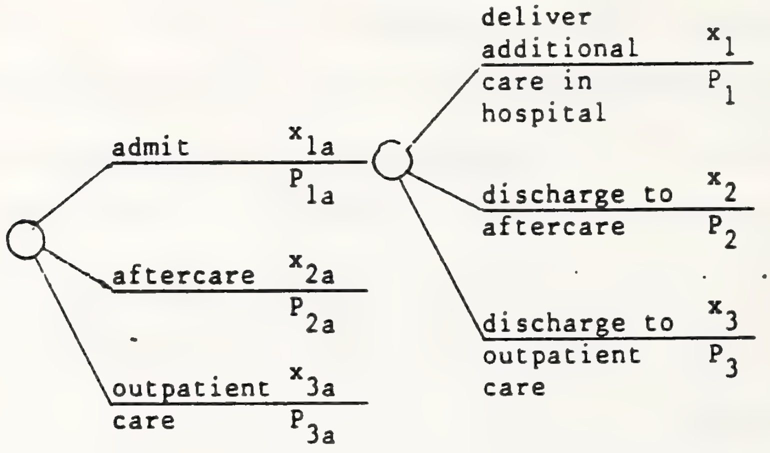


Figure 3: A Simple Model

If a patient is admitted to the hospital, then the physician is faced with a second decision: namely, to provide the requisite quantum of necessary services in the hospital (using the bundle of hospital services x_1; x_1 may be a vector describing the quantity of specific inpatient services used, or it may be a summary statistic such as hospital days), or to discharge the patient and provide those services either in an aftercare facility (using the bundle of aftercare services x_2) or in his or her office or the hospital outpatient department (using the outpatient bundle x_3). The probability that he will choose the ith alternative (i=1 to 3) for the kth patient is a function of his or her preferences and the patient's clinical state; the expected use of services of the ith type for the kth patient is $P_{i_k} x_i$, and the expected use of services of the ith type over all patients with that illness is

---

[2] It is convenient to let x_{1a} be a vector of inpatient services comprising one admission and some quantities of other services.

$$\sum_k P_{i_k} x_i \text{ (i=1,2,3) over all patient(episode)s.}$$

The expected mix of services, then, for any condition "j" is

$$U(j) = \sum P_{1a_k} x_{1a} + P_{2a_k} x_{2a} + P_{3a_k} x_{3a} + P_{1a_k}\left(P_{1_k} x_1 + P_{2_k} x_2 + P_{3_k} x_3\right)$$

where

P_{1a} = probability of hospitalization given evaluation;

P_{2a} = probability of aftercare instead of hospitalization, given evaluation;

p_{3a} = probability of outpatient care instead of hospitalization, given evaluation;

x_{1a} = hospital services delivered on admission;

x_{2a} = requisite quantity of aftercare services needed to substitute for all hospital services for care of episode;

x_{3a} = requisite quantity of outpatient services needed to substitute for all hospital services for care of episode;

p_1 = probability of providing care exclusively in hospital;

p_2 = probability of substituting aftercare services for hospital care, given hospitalization;

p_3 = probability of substituting outpatient services for hospital care, given hospitalization;

x_1 = requisite quantity of hospital services, in excess of x_{1a}, for care of episode;

x_2 = requisite quantity of aftercare services, in excess of x_{1a}, for care of episode;

x_3 = requisite quantity of outpatient services, in excess of x_{1a}, for care of episode; and k = index for each episode of illness j presenting for evaluation.

We predict that changes in the relative attractiveness of various bundles of services as the result of new incentives introduced by PPS will lead to changes in physician allocative decision-making, and that there will be changes in P_{1a}, P_{2a}, P_{3a}, P_1, P_2, and P_3 (with the post PPS values written as: P^*_{1a}, P^*_{2a}, P^*_{3a}, P^*_1, P^*_2, and P^*_3). We hope to demonstrate these changes in physician behavior by observing changes in those measurables which reflect them: namely, hospital admission rates and mix of services. The change in the utilization of services as the result of PPS is, therefore

$$U^*_j - U_j = \sum_{k^*} \left(P^*_{1a_k} x_{1a} + P^*_{2a_k} x_{2a} + P^*_{3a_k} x_{3a} + P^*_{1a_k} (P^*_{1_k} x_1 + P^*_{2k} x_2 + P^*_{3k} x_3)\right)$$

$$- \sum_{k} \left(P_{1a_k} x_{1a} + P_{2a_k} x_{2a} + P_{3a_k} x_{3a} + P_{1a_k} (P_{1k} x_1 + P_{2k} x_2 + P_{3k} x_3)\right)$$

$$= \left[\sum_{k^*} P^*_{1a_k} - \sum_{k} P_{1a_k}\right] - \left[\left(\sum_{k} P^*_{1a_k} P^*_{1k} - \sum_{k} P_{1a_k} P_{1k}\right) X_1\right] +$$

change in admissions   change in hospital services, given admission

$$\left[\left(\sum_{k^*} P^*_{2a_k} - \sum_{k} P_{2a_k}\right) x_{2a} + \left(\sum_{k^*} P_{1a_k} P^*_{2k} - \sum_{k} P_{1a_k} P_{2k}\right) x_2\right] +$$

aftercare substitution

for hospitalization   for hospital stay

$$\left[\left(\sum_{k^*} P^*_{3ak} - \sum_{k} P_{3ak}\right) x_{3a} + \left(\sum_{k^*} P^*_{1ak} P^*_{3k} - \sum_{k} P_{1ak} P_{3k}\right) x_3\right] \qquad (1)$$

outpatient substitution

for admission   for hospital stay

The probability that we will see changes in admission rate and service use, given that there are in fact changes in physician behavior (hence in the P's) will depend upon the likelihood that

$$\sum_{k^*} P_{1a_k} - \sum_{k} P_{1a_k}$$

and that

$$\Big(\sum_{k^*} P^*_{ia_k} - \sum_{k} P_{ia_k}\Big)x_{ia} + \Big(\sum_{k^*} P^*_{1a} P_{i_k} - \sum_{k} P_{1a_k} P_{i_k}\Big)x_{i} \qquad (i=1-3)$$

are different from zero. Conversely, the likelihood that demonstrable differences in observed rates of admission or service use legitimately reflect changes in physician behavior induced by PPS depends upon the likelihood that confounding changes in other variables have been excluded.

It is our belief that the quantities above are design parameters, subject to experimenter control, and that rational choice of conditions for study, based on consideration of optimal design characteristics, can increase the sensitivity and specificity of tracer-based analyses in health services research. Therefore, we next consider what are the parametric requirements for maximum sensitivity and specificity for a variety of analyses, and what are the characteristics of various medical conditions with respect to those parameters that might make them well or ill suited as tracers.

Development of Tracers: General Considerations

1. Prevalence in the study population

Clearly, prevalence of condition in the population is necessary if the study group is to provide meaningful insight into the processes under investigation. Furthermore, if tracer-based analyses are to be generalizable, it is logically necessary that the population affected must be a nontrivial proportion of the total population.

Formally, prevalence in the population implies that the number of episodes (k) is large. It is clear that the differences in the above equations are unlikely to be large if the sums involve small numbers of elements. Large numbers, of course, do not insure large differences.

Different conditions vary widely with respect to their prevalence in the Medicare population. Table 1 lists those conditions which are the most frequent (principal) medical diagnoses and (principal) procedures (ICD-9 codes) in a sample of MEDPAR 5 data.

2. "Diagnostic stability" (insensitivity to "diagnostic drift")

If one is attempting to investigate the effect of system shock (e.g., PPS) on some measure of system behavior (e.g., service use) by evaluating that effect on a set of cases defined by a tracer condition, it is usually necessary that there be no independent effect of that shock on the nature of the cases defined by that tracer. This will be necessary whenever system behavior may vary strictly as the result of variations in case definition. If, for example, that which is defined as "acute myocardial infarction" after PPS is, qualitatively or quantitatively, different from that which is defined as AMI before PPS, then changes in the allocation of resources for the care of individuals with that tracer condition will reflect the combined effects of PPS on resource allocation (the process of interest), and on tracer case mix. Without data intensive mechanisms for adjusting for potential case mix changes (diagnostic drift or creep), it will be impossible to isolate the direct effects of PPS on resource use from its effects on tracer mix.

Formally, case mix stability requires that the distribution of k^* be the same as that of k with respect to any critical parameter. With respect to resource allocation, the most relevant parameter is clinical state (or severity of illness);[3] that is, the distribution of severity of illness for those episodes which enter the data set after PPS should be comparable to that for episodes which enter before PPS. Without this stability there will be systematic differences in $(P_1^*k^*-P_1k)$'s, which will be unrelated to changes in physician attitude; hence changes in service use will be difficult to interpret without data intensive case mix adjustments. In the absence of a random epidemiologic shock to the Medicare population (e.g., an epidemic), there are two factors which may threaten the stability of casemix. First of all, discretionary changes in diagnostic coding may have the effect of changing casemix severity; such coding changes are likely to be motivated by PPS. This may be viewed as a form of "diagnostic creep." Alternatively, changes in the behavior of the health care system may lead to the systematic presentation of episodes which are more severe; in this case, the true distribution of severity of illness in the population at large is unchanged but the severity of illness in the observed population (i.e., those episodes that lead to medical attention; hence entry into the data set) is different. For example, if PPS motivates changes in the delivery of health care, the effect of which is to discourage patients from seeking medical attention (as it might, were it to shift inpatient care to the doctor's office, thereby increasing the complexity of the physician's average office encounter, increasing the length of that average encounter, constraining the number of daily encounters and increasing queue lengths), then it is probable that only the more severe episodes of illness would come to medical attention, and that cases would come to attention only when they had progressed, on average, to a more severe stage. In this setting, the observed population would in fact have changes with respect to its underlying severity of illness, and the probable mix of services for the average patient would have changed as well. This is true, by the way, whether the change in probability or evaluation (given clinical state) is motivated by PPS (as in the parenthetical example) or is motivated by something else (as, for example, secular trend).

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[3] Formally, however, changes in the distribution of other elements of the decision-relevant vector need to be stable as well. For example, changes in patient attitudes about hospitalization, or in queue lengths at the doctor's office as the result of PPS, may affect resource allocation decisions independent of the effect of PPS on the "price" the physician faces for using services. In this case, changes in resource use after PPS will legitimately reflect a PPS effect -- but not necessarily the effect presumed.

We suggest two mechanisms for minimizing the impact of system shock on diagnostic definition. The first, and in some ways less satisfying, is to aggregate related diagnoses to internalize potential coding changes: that is, where the expectation is that cases that might have been coded ICD-X before PPS are now being coded ICD-Y, are defined as the study condition tracer XY, into which all patients with ICD-X and ICD-Y fall both before and after PPS. Thus inter-diagnosis coding changes -- systematically related to tracer condition resource use -- become intra-tracer coding changes -- irrelevant with respect to tracer condition resource use. "Diagnostic drift" is not a problem as long as nothing has drifted into (or out of) the observational pool.

The problem with such aggregation is obvious. The more heterogeneous the tracer group, the less likely it is that an effect will be seen. This is merely to restate the rationale for the use of tracers. At the limit, no drift occurs if all diagnoses are aggregated (that is, all cases are examined collectively); on the other hand, important effects which may depend upon the specific nature of some conditions are likely to be overwhelmed.

An alternative to extensive aggregation of related diagnoses is selection of those conditions at lowest risk for discretionary recoding. **Ceteris paribus**, this is the superior alternative; but how is one to define those "at lowest risk for recoding"? This, we suggest, depends upon judgment, the quality of which will depend upon familiarity with the clinical conditions that ICD-9 codes represent, and the clinical/pathological/etiological ambiguities which may exist to facilitate coding discretion. We assert, based upon our experience, that some sets of ICD-9 codes are more subject to discretionary assignment than are others. For example, considerably more discretion exists with respect to the assignment of the diagnosis "other angina" (i.e., angina other than variant and pre-infarction angina ICD-9 413.9), for which the alternatives cardiac ischemia (411.8) and coronary atherosclerosis (414.) exist than for the diagnosis BPH (600). We suggest, therefore, that BPH (ICD-9 600) would be a superior tracer to angina (ICD-9 413.9).

The choice of aggregation scheme is somewhat arbitrary. Table 2 is a list of those diagnostic aggregates that we believe are sufficiently homogeneous to be meaningfully considered as tracer diagnoses for health services studies, and sufficiently broad-based to guard against significant changes in composition as the result of coding changes induced by PPS. The table borrows heavily from the tabulation of the CPHA, which we have found to be intelligently conceived and of use in our work.

3. Insensitivity to changes in technology

Insofar as we are interested in the use of tracers to evaluate changes in the patterns of resource allocation as the result of PPS, it is necessary to control for changes in resource use which might evolve in parallel with, but causally independent of, PPS. The greatest such changes are likely to occur for those conditions for which advances in technology drive new allocation schemes: for example, the introduction of a new device which permits the substitution of outpatient care for inpatient care,[4] or a new procedure which permits similar substitutions.[5] Even more subtle technological innovations than these may have profound impact on resource use -- the introduction of new intravenous cardiac inotropes (for example, milrinone and amrinone) has increased the likelihood of elective hospitalization for patients with end-stage CHF; the development of oral agents will increasingly effect the transfer of this care elsewhere. Similarly, demonstration of the safety and efficacy of ambulatory/day care surgery (e.g., for inguinal hernia repair or TURP) has directly led to the possibility of the substitution of outpatient department care for inpatient care (for patients with these diagnoses). Thus, changes in physician practice may reflect underlying physician preferences newly made manifest as the result of technologic innovation contemporaneous with the introduction of PPS and not changes in physician preferences directly as the result of the introduction of PPS.[6]

Formally, such changes in technology are changes in the values of x_{1a}, x_{2a}, x_{3a}, x_1, x_2, and x_3) -- the requisite quanta of services necessary to provide care over any period between evaluations. Changes in the technology of care lead to changes in those quanta; in general, those changes will have unpredictable effects on physician decision making. Therefore, the need for technologic stability is a prerequisite of the model.

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[4] For example, the subcutaneous continuous infusion pump used for the delivery of chemotherapy.

[5] For example, PTCA, which has facilitated the substitution of outpatient management for selected patients with CAD for inpatient surgical management of their disease (or vice versa).

[6] Which is not to say that the stimulus for technologic innovation of some types (namely, those that effect shift of patient care from inpatient to outpatient departments) is necessarily unrelated to PPS.

A discussion of technological innovation in medicine would be much beyond the scope of this paper. We hope to alert the reader to the desirability of selecting as tracers those conditions least affected by new technologies, and to assert, based on our judgment, that the conditions in Table 2 are more or less desirable. Examples of our conclusions are presented in Table 3.

Specific Considerations

If we assume that case mix distribution is stable despite PPS, then Equation 1 simplifies (somewhat) to

$$\Big(\sum_k P^*_{1a}-P_{1a}\Big)x_{1a} + \Big(\sum_k P^*_{1a}P^*_{1}-P_{1a}P_{1}\Big)x_{1} + \left[\Big(\sum_k P^*_{2a}-P_{2a}\Big)x_{2a} + \Big(\sum_k P^*_{1a}P^*_{2}-P_{1a}P_{2}\Big)x_{2}\right]$$

$$+ \left[\Big(\sum_k P^*_{3a}-P_{3a}\Big)x_{3a} + \Big(\sum_k P^*_{1a}P^*_{3} - \sum_k P_{1a}P_{3}\Big)x_{3}\right]$$

$\sum P^*_{1a} - P_{1a}$ represents the change in tendency to admit a patient, given severity of illness defined by k;

$\sum P^*_{2a} - P_{2a}$ represents the change in the likelihood that hospitalization will be averted by means of substituting x_{2a} aftercare services;

$\sum P^*_{3a} - P_{3a}$ represents the change in the likelihood that hospitalization will be averted by means of substituting x_{3a} outpatient department services;

$\sum P^*_{1} - P_{1}$ (because $P^*_{1a} = P_{1a} = 1$, conditional on hospitalization) represents the change in likelihood to employ x_1 hospital services to complete the care of the episode;

$\sum P^*_{2} - P_{2}$ represents the change in the likelihood that x_2 aftercare services will be employed instead; and

$\sum P_3^* - P_3$ represents the change in the likelihood that x_3 outpatient services will be employed instead.

What we can measure are changes in hospital admission rates, changes in hospital service use (over all episodes, and conditional on admission), changes in aftercare services (over all episodes), and changes in outpatient department services (over all episodes), for any condition. The conditions that will prove to be most sensitive to discovering changes in system behavior will differ depending upon the change under scrutiny. These are discussed below.

The Choice of Tracers in Analyses of Hospital Admission

A change in hospital admission practice will be manifest if and only if there is a change in $\sum P_{1a}$ under PPS. This will occur if PPS induces a change in the probability of admission given clinical state (that is, in the P_i function), _and_ that change occurs in a clinical state region which is frequently encountered. Clearly, if the probability function does not change, $P_{1a}^* - P_{1a}$ is identically zero. Clearly, too, if the probability function changes, but only in a region for which P_{1a} is rarely encountered, that change will contribute little to the $\sum P_{1a}^* - P_{1a}$, and the expression will be practically zero. Therefore, the characteristics of a tracer diagnosis which optimizes the probability that a change in hospital admission practice will be uncovered are that:

1. The distribution of cases among all those with that condition will be such that the probability of admission for a randomly chosen episode will be frequently neither zero nor one.

2. That probability function is expected to change under PPS.

This is shown graphically in Figure 4.

From a theoretical standpoint, it is those conditions for which effective outpatient modalities for care currently exist that are most likely to generate probability of admission functions of the type desired. The characteristics of the optimal tracer become evident from consideration of those conditions anticipated to be nonoptimal: that is, those conditions for which outpatient care is generally infeasible. Insofar as outpatient and aftercare facilities generally provide nonintensive monitoring, noninvasive diagnostic and therapeutic options, and a range of nursing services, it is those conditions for which extraordinary monitoring, diagnostic or therapeutic services, or nursing care are needed that are generally least likely to offer the physician discretion with respect to patient disposition. Conditions which require extraordinary monitoring include myocardial infarction, unstable angina, cardiac rhythm disorders, gastrointestinal bleeding, syncope -- conditions which, with high probability, result in intensive care admission. Conditions which require extraordinary diagnostic or therapeutic maneuvers include most invasive diagnostic and therapeutic procedures (for example, most surgery) as well as those which require the use of potentially hazardous pharmaceuticals (for example, most malignancies, acute pulmonary embolus, and many cardiac rhythm disorders). In these cases, the need for hospitalization usually arises because of the need for intensive monitoring over the interval following the relevant maneuver. Conditions requiring extraordinary nursing care are those -- for example, stroke or burns -- for which the quality or the quantity of care needed is beyond the ability of the family to provide.

Data exist to help add empiricism to the theoretical formulation above. Schonfeld has tabulated "Standards of Medical Practice," from which observed frequencies of hospitalization exist for a large number of medical conditions. We may take these observed frequencies as estimates for the true probability of admission, given clinical evaluation: as noted, the optimal tracer will have an average probability that is neither zero nor one. Table 4 summarizes, for many of the potential tracers previously discussed, what are the estimates from Schonfeld for the true probability of admission. To these we might add TURP, IHR, and other surgical procedures for which ambulatory options for care newly exist.

The Choice of Tracers in Analyses of Substitution of Aftercare for Hospitalization

The substitution of aftercare services for hospital services at the level of admission leads to the utilization of additional x_{2a} aftercare services. The conditions which make it most likely that there will be a change in overall aftercare service use

$$\left(\sum P_{2a}x_{2a} + \sum P_{1a}P_{2}x_{2}\right)$$

which is attributable to this substitution are those conditions for which x_{2a} is large and x_2 is not, and/or for which $(P^*_{2a} - P_{2a})$ is large and $(P^*_2 - P_2)$ is not. We do not think that any of the prevalent medical or surgical conditions are satisfactory in this regard, however, nor do we think that this substitution is likely to occur frequently.

The Choice of Tracers of Analyses of Substitution of Outpatient Department Care for Hospitalization

The substitution of outpatient department services for hospital services at the level of first evaluation leads to the use of additional x_{3a} outpatient department services. As above, the conditions which make it most likely that there will be a change in overall outpatient department use

$$\left(\sum P_{3a}x_{3a} + \sum P_{1a}P_{3}x_{3}\right)$$

which is attributable to this substitution are those conditions for which x_{3a} is large and x_3 is not, and/or for which $(P^*_{3a} - P_{3a})$ is large, and

$(P_3^* - P_3)$ is not. Among those medical conditions for which there is some probability of substituting outpatient care for hospital care, there is none for which it is obvious that the quantity of outpatient care needed to eliminate the first hospital day(s) (that is, x_{3a}) is large relative to the quantity of care that would be needed to eliminate the remainder of the (conceivably more dispensable) hospital care (that is, x_3). However, given that we anticipate that, in general, outpatient department/doctor's office care will replace the care of those individuals whose hospitalizations are eliminated, we anticipate that there will be a reciprocal increase in the use of outpatient services for those conditions chosen as tracers above.

However, for those surgical procedures for which there is some probability of substituting outpatient care entirely for hospital care, the quantity of care that will be substituted for hospital admission will be qualitatively distinctive from the quantity of care that will be substituted for additional hospital days. Therefore, the vector x_{3a} will be very different from the vector x_3, and it should be straightforward to determine where changes in outpatient service use reflect substitution for hospitalization. Analysis of changes in the utilization of outpatient services (for example, operating room time or surgeon's time) for these conditions is likely to be most sensitive to changes in physician decision-making. Because outpatient departments vary with respect to their capacity for surgery, it is difficult to enumerate all of those procedures which can now be accomplished out of the hospital. Some of the more common are listed in Table 5.

Considerations in Analyses of Substitution of Ambulatory Services for Inpatient Services

The substitution of outpatient services (aftercare or OPD) can be evaluated similarly, and the characteristics of optimal tracers described. The substitution of aftercare or OPD services can be viewed as alternatives at a chance node where the physician chooses to use additional inpatient services x_1 (with probability P_1) or to substitute x_2 aftercare services or x_3 OPD services. These substitutions occur with probabilities P_2 and P_3, respectively, where these probabilities, as before, are functions of physician preferences and patient state. Conditional on admission, the expected use of aftercare services is P_2x_2, the expected use of outpatient department services is P_3x_3, and the expected use of hospital services is P_1x_1 (where $p_1 = 1-(P_2+P_3)$).

If we suspect that PPS alters physician preferences with respect to the choice of service mix, then we predict that there will be a shift in the functions representing the probabilities of employing services of each type, given a specified level of need. In particular, we expect the probability of aftercare or OPD service use to increase for all patients and the probability of continued hospital service use to decrease (reflecting incentives to the physician to divert patient care away from the hospital).

For any episode of illness, the change in utilization of services (still conditional on admission) under PPS will depend upon the product $(P_i^*-P_i)x_i$ (i=1-3); for any condition, the change in utilization over all episodes k will be $\sum (P_i^*-P_i)x_i$. The tracer condition that will be most sensitive to changes in physician behavior with respect to choice of service i will be that for which that sum is largest. These are considered below.

- Aftercare Services

It is uncertain, **a priori**, what will be the conditions for which $(P_2^* - P_2)$ will be largest; in general, there ought to be greater motivation to utilize aftercare services as alternative to inpatient services for all conditions, given that hospital savings derive in largest part from saving hospital days, and that hospital days are not greatly different among all those conditions for which aftercare substitution is feasible. Conditions will vary predictably, however, with respect to the extent to which aftercare can substitute for inpatient care for any episode of illness (that is, will vary with respect to the magnitude of x_2), and with respect to the fraction of hospitalized episodes for which x_2 is large (that is, P_2^* will more often be nonzero -- a necessary, albeit insufficient, condition for $P_2^* - P_2$ to be nonzero). For example, we predict that THR will be superior to cholecystectomy as a tracer for studies on the substitution of nursing home and home health care services for hospital services, both because the nursing needs of patients post THR exceed those, on average, of patients post cholecystectomy, and because the proportion of patients who have those needs is higher among THR patients than among cholecystectomy patients. Thus, the sum above is likely to be larger for patients admitted for THR than for cholecystectomy, and we are more likely to see the effect of PPS.

In general, those conditions for which x_2 is expected to be large are those for which nursing needs are great; those conditions for which P_2^* is expected to be nonzero are those for which the substitution of nursing care for hospital care is feasible (namely, conditions for which little beside nursing care is needed). The former can be identified by examining the population of individuals that currently require aftercare services while the latter can be estimated as the observed frequency with which individuals with a condition are in fact discharged to aftercare services. Tables 6 and 7 summarize current data on the distribution of conditions among Medicare patients submitting bills for aftercare (HHA and SNF) services, and on the frequency with which Medicare patients with various conditions are discharged from the hospital to aftercare services.

- OPD Services

Similar considerations obtain with respect to the substitution of OPD care for inpatient care. Here, however, we expect X_3 to be large for conditions for which prolonged medical care is necessary, and expect P_3^* to be nonzero to the extent that other aspects of care are minimal. We suspect that the magnitude of x_3 will vary with observed length of hospital stay, although that correlation will be imperfect. Table 8 summarizes data on length of stay for many of the prevalent DRGs. We anticipate, as well, that P_3^* will vary inversely with P_2^* (that is, the more likely are aftercare services, the less likely are OPD services to be substituted), although note that it is principally the use of skilled nursing services (as would occur in a SNF) which make discharge with outpatient department (or doctor's office) follow-up unlikely.

Considerations in Analyses of changes in Use of Hospital Services

Insofar as x_1 represents a quantum of additional inpatient care to be delivered for one episode of illness, given hospitalization, changes in utilization of inpatient services after PPS can be considered to be strictly the result of changes in the probabilities that those services will be employed at the pre-PPS rates; that is, the observed utilization post PPS, $P_1^* x_1$, differs from the observed utilization pre PPS, $P_1 x_1$, by the amount $(P_1^* - P_1)x_1$. The change in utilization of hospital services for any condition is thus the sum over all episodes $\sum (P_1^* - P_1)x_1$.

Conditions for which that sum is minimized (that is, made largest in absolute value; we expect utilization of services to decrease) will depend upon the specific services under consideration. Length of hospital stay (that is, utilization of those services which comprise routine daily care) is most likely to fall for those conditions for which there is a significant increase in the probability of discharge given clinical state function

$[(1-P_1^*)-(1-P_1) = P_1-P_1^*]$, and for which x_1 is large. Because $P_1 = 1-(P_2+P_3)$ (and $P_1^* = 1-(P_2^*-P_3^*)$), $P_1-P_1^*$ is largest when $(P_2^*-P_2) + (P_3^*-P_3)$ is largest; that is, when there is a substantial increase in the probability of substitution of ambulatory modalities of care for inpatient care. We suggest, therefore, that the conditions which will serve best as tracers for evaluation of changes in length of hospital stay are those conditions for which there is a high probability of substitution of services, and those conditions for which lengths of stay are large. Similarly, use of ancillary services is most likely to fall for those conditions for which substitution of other services (either more cost-effective inpatient alternatives, or ambulatory alternatives) is likely, and for which service use pre-PPS is great. Table 8 summarizes length of stay and relative weighting factors (which depend upon length of stay and ancillary service use) for many of the prevalent DRGs.

It is, of course, the change in use per episode, summed over all episodes, that will be observed. Thus, it is only for the observed distribution of clinical states that these changes in probability of service use will be discernable. Ideally, that distribution will be stable -- otherwise, changes in discharge behavior will reflect the interaction of changes in physician attitudes toward hospitalization for patients in a given clinical state, and changes in the distribution of patients of a given clinical state among those in the hospital. If the latter changes under PPS, as would be expected if there is a change in physician attitudes about the need for hospitalization, then the impact of PPS on hospital service utilization will not necessarily be ascertainable. If, however, the impact of PPS is to increase the severity of illness among those hospitalized (that is, to reduce the probability of admission given clinical state), then the demonstration of a decrease in hospital service use among patients hospitalized for a given condition is more compelling evidence for the existence of a PPS effect on physician discharging behavior.

Under these circumstances, the optimal tracer for use in studies on utilization of hospital services (conditional on admission) should be a condition for which hospitalization is nondiscretionary (so that changes in the mix of patients that are hospitalized are minimized), and for which substitutes for hospital services currently exist. Such nondiscretionary conditions include those medical conditions in Table 4 for which the probability of admission is approximately 1.0 and most surgical conditions. We believe that some elective surgical procedures should be included among these nondiscretionary conditions. Although hospitalization for an elective procedure is clearly discretionary, it seems likely that -- for those procedures (e.g., cataract surgery, total joint replacement) for which the timing of surgery depends upon the level of symptoms, and may not correlate with severity of illness in a resource allocative sense -- this discretion will not much affect the distribution of clinical states among those hospitalized for those procedures.

Summary and Recommendations

Consideration of the above suggests that conditions can be chosen for use as tracers in such a fashion as to maximize the sensitivity of any analysis for the effect one is attempting to study. In particular, the characteristics of a condition which are relevant to its use as a tracer in a particular study are summarized below:

	Characteristic of Condition								
Analytic Problem	P_{1a}	P_{2a}	P_{3a}	x_{1a}	x_{2a}	x_{3a}	x_1	x_2	x_3
Changes in hospital admission rate	$0<P<1$	-	-	-	-	-	-	-	-
Changes in hospital service use (including LOS)	1	-	-	-	-	-	large	-	-
Substitution of aftercare for hospitalization	-	-	-	-	large	-	-	small	-
Substitution of aftercare for hospital days/services	1	-	-	-	small	-	large	large	-
Substitution of outpatient care for hospitalization	-	-	-	-	-	large	-	-	small
substitution of outpatient care for hospital days/services	1	-	-	-	-	small	large	-	large

A summary table for many of the conditions evaluated in the earlier part of the work follows (Table 9). From this table, it is clear that a number of conditions may serve suitable as tracers, in one or several of the analyses to be undertaken. A parsimonious list would include pneumonia (which should offer insight into changes in admission policies, changes in discharge policies, and the substitution of outpatient care for inpatient care which those imply); stroke/related diagnoses (which would offer insight into changes in discharge policies and the substitution of aftercare for hospital care); total hip replacement (which should offer insights similar to those for stroke); and inguinal herniorraphy or an alternative procedure shifting to the OPD (which should offer insight into changes in admission policies). Additional conditions which are prevalent and likely to provide complementary insights include congestive heart failure, pulmonary embolus, chronic obstructive pulmonary disease, acute myocardial infarction, other major joint procedures, and hip/femur fracture.

Analytic power is greater if the analysis is extended to include some of those conditions for which substitution of care is least likely. We expect this group to serve as a control -- given that we expect no discretion to exist with respect to the management of patients with these conditions. Changes in the management of patients with these conditions serve as a baseline with which changes in the former group can be compared. Pulmonary embolus, acute myocardial infarction and THR, for example, could serve as controls of this sort in analyses of changes in hospitalization policy.

Table 1

Prevalence of Conditions (by 5-Digit ICD-9 Code) in Sample of MEDPAR 5 Percent

Condition	ICD-9	n(1982)	Percent of Cases (1982)
Congestive heart failure	428.0	392	3.40
Unspecified cataract	366.9	275	2.39
Coronary atherosclerosis	414.0	266	2.31
Other unknown/unspecified ssx	799.95	263	2.29
	799.9	253	2.20
Acute, ill defined, cerebrovascular	436	212	1.84
Pneumonia, organism unspecified	486	211	1.83
Chronic airway obstruction, not elsewhere classified	496	201	1.75
Hyperplasia of prostate	600	175	1.52
AMI, unspecified site	410.9	156	1.36
DM, adult onset, with complications	250.0	134	1.16
Other, unspecified angina pectoris	413.9	127	1.10
Unspecified trans. cerebral ischemia	435.9	114	.99
Urinary tract infection, site unspecified	599.0	112	.97
Otherwise unspecified noninfectious gastroenteritis and colitis	558.9	111	.96
Maglignant neoplasm of prostate	185	111	.96
Unspecified hypertension	401.9	110	.96
Malignant neoplasm of bronch./lung unspecified	162.9	167	.93
Fx, unspecified part of neck of femur, closed hip	820.8	90	.78
Hemorrhage of gastrointestinal tract, unspecified	578.9	87	.76
Chronic ischemic heart disease, unspecified	366.10	77	.74
Diverticulosis of colon	562.10	78	.68
Senile cataract, unspecified	366.10	77	.67
Atrial fibrillation	427.31	75	.65
Inguinal hernias obstruction or gangreen	550.90	73	.63
Chest pain, unspecified	786.50	71	.62
Abdominal pain	789.0	70	.61
Unspec. intest obstr.	560.9	70	.61
Volume depletion	276.5	68	.59
Acute bronchitis	466.0	67	.58
Intermediate coronary synd.	411.1	66	.57
Anemia, unspecified	285.9	66	.57
Syncope and collapse	780.2	63	.55
Asthma, unspecified, with status asthma	493.90	57	.47
Diaphragmatic hernia	553.3	52	.45
Chronic renal failure	585	51	.44
Diverticulitis of colon	562.11	51	.44

Table 1 (continued)

Condition	ICD-9	n(1982)	Percent of Cases (1982)
Cardiovascular disease, unspecified	429.2	51	.44
Bronchitis, not specified as chronic or acute	490	50	.43
Malignant neoplasm of bladder, part unspecified	188.9	50	.43
Cardiac dysrythmia, unspecified	427.9	48	.42
Hypertensive heart disease, unspecified without CHF	402.90	48	.42
Malignant neoplasm of breast (0^{t}), unspecified	174.9	47	.41
Other ill-defined conditions	799.8	46	.40
RA	714.0	46	.40
Malignant neoplasm, site unspecified (with dissemination)	199.1	44	.38
Calculus of gb with other cholecystitis (not acute)	574.10	43	.37
Occlusion and stenosis of carotid artery	433.1	42	.37
Intertrachial section, neck of femur	820.21	41	.36
OA, unspecified	715.90	41	.36
Convulsions	780.3	40	.35
Other acute or subacute ischemic heart disease	411.8	39	.34
Other unspecified alcohol dependency	303.90	37	.32
Malign neoplasm colon unspecified	153.9	37	.32
Multiple myeloma	203.0	36	.31
OA, unsp, lower leg	715.96	35	.30
Calculus or gall bladder without ment. of cholecyst.	574.20	35	.30
Generalized & unspecified atherosclerosis	440.9	34	.30
AMI inferior wall	410.4	34	.30
Unspecified gastritis/gastroduoden.	535.5	33	.29
Heart failure unspecified	428.9	33	.29
Hematuria	599.7	30	.26
Left heart failure	427.81	30	.26
Other, ill-defined cardiovascular disease unspecified	437.9	29	.25
Unspecified nonpsych. mental disease following organic brain damage	310.9	29	.25
Ulcer of lower limb except decubitis	707.1	28	.24
Fx neck of femur, other	820.09	27	.24
Cerebral arterial occlusion, unspecified	434.9	27	.24
Total or mature cataract	366.17	27	.24
Other cholecystitis	575.1	26	.23
Pulmonary congestion and hypostasis	514.	26	.23

Table 1 (continued)

Condition	ICD-9	n(1982)	Percent of Cases (1982)
Other emphysema	492.8	26	.23
Phlebitis and thrombophl. of lower extremity, unspecified	451.2	26	.23
Peripheral vascular disease, unspecified	443.9	26	.23
Dyspnea and respiratory abnormalities	786.09	25	.22
Gangrene3	785.4	25	.22
Pyelo., unspecified	590.80	25	.22
Renal failure, unspecified	586	25	.22
Acute gastritis	535.0	25	.22
Heart dis unspecified	429.9	25	.22
Cardiac arrest	427.5	25	.22
AMI, anterolat.	410.1	25	.22
Iron deficiency, anemia unspecified	280.9	25	.22
Diabetes, with unspecified complication	250.90	25	.22
Pyrexia of unknown origin	780.6	24	.21
Cardiac dysrhythmias	427	24	.21
Other primary cardiomyopathies	425.4	23	.20
Cellulitis, abscess leg excluding foot	682.6	22	.19
Acute pancreatitis	577.0	22	.19
** Achalasia and cardiospasm	530.1	22	.19
Bronchopneum, orig. unspecified	485	22	.19
Unspecified psychosis	298.9	22	.19
Retention of urine	788.2	21	.181
Lumbago	724.2	21	.181
Pulmonary embolism and infarction	415.1	21	.181
Spondylosis of unspecified site without mention of myelop.	721.90	20	.17
OT, unspecified pelvis and thigh	715.95	20	.17
Postmenopausal bleeding	627.1	20	.17
Hemorrhage of rectum and anus	569.3	20	.17
Unspecified pleural effusion	511.9	20	.17
Paralysis agitans	332.0	20	.17
Depressive disorders, not elsewhere classified	311	20	.17
Unspecified septicemia	038.9	20	.17

** EITHER WRONG CODE OR WRONG DISEASE

Table I (Part II)

Prevalence of Procedures (by 5 digit ICD-9 Code)
in Sample of MEDPAR 5 percent (1982) (50 most prevalent)
Table 1 (continued)

Condition (0000/0060?)	ICD-9	n(1982)	Percent of Cases (1982)
Other (transurethral) cysoscopy	57.32	194	1.69
Other intracapsular lens extract	13.19	190	1.65
Transurethral prostatectomy	60.2	147	1.28
Total cholecstectomy	51.22	105	0.91
Other endoscopy of large intestine	45.24	93	.81
Other extracapsular lens extraction	13.59	84	.73
Insertion of intraocular lens prosthesis (at cataract extraction)	13.71 **	71	.62
Unlateral repair, inguinal hernia nos	53.00	65	.57
Other endosc. of small intestine	45.13	50	.43
ORIF, femur	79.35	48	.42
Other replacement, head of femur	81.62	40	.35
Exploratory laparotomy	54.11	38	.33
Other transurethexcision or destruction of lesion or tissue of bladder	57.49	36	.31
Other bronchoscopy	33.23	34	.30
Other local excision or destruction of lesion/tissue of skin, subcutaneous tissue	86.3	33	.29
Other THR	81.59	32	.28
Other dilation and curettage (D&C)	69.09	31	.27
Other proctosigmoidoscopy	48.23	31	.21
Endart, other vessels head and neck	38.12	31	.27
Other gastroscopy	44.13	30	.26
Insertion permanent cardiac pacer unspecified approach	37.77	28	.24
Debridement wound, infection, burn	86.22	25	.22
Total knee replacement	81.41	22	.19
ORIF unspecified site	79.30	22	.19
Other hernia repair	53.9	22	.19
Right hemicolectomy	45.73	22	.19
Endosc. bronchial biopsy	33.24	22	.19
TAH	68.4	21	.18
Sigmoidectomy	45.76	21	.18
Other periph. (vascular shunt or bypass)	39.29	20	.17
Other biopsy of breast	85.12	18	.16
Fiberoptic bronch	32.22	18	.16
Local excision lesion of breast	85.21	17	.15
Dilation of urethra	58.6	17	.15
Insertion cardiac pacer nos	37.70	17	.15
Vaginal hysterectomy	68.5	16	.14
Needle biopsy of prostate	60.11	16	.14
Phacoemulsification of cataract	13.41	16	.14

** EITHER WRONG PROCEDURE OR WRONG CODE 13.70?

Table 1 Part II (continued)

Condition	ICD-9	n(1982)	Percent of Cases (1982)
Transfusion of packed cells	99.04	15	.13
Other repair of hip	81.69	15	.13
Aorto-coronary bypass 3v	36.13	15	.13
AKA	84.17	14	.12
Release of curpal tunnel	04.43	14	.12
IF with OR femur	78.55	13	.12
Nephroureterectomy	55.51	13	.12
Colostomy. nos	46.10	13	.12
Other exploration and decomp. spinal canal	03.09	13	.12
Other bunionectomy	77.59	12	.10
Lysis of peritoneal adhesions	545	12	.10
Excision of hemorrhoids	49.46	12	.10
Other partial resection of small intestine	45.62	12	.10
Incision of lower limb vessel	38.08	12	.10
Aortocoronary bypass nos	36.10	12	.10
Other scleral buckling	14.49	12	.10

Table 2

Reasonable Homogeneous Tracer Options

Diagnostic Aggregate	ICD-9 Codes
Senile Cataract	366.1, 366.9
Hypertensive Heart disease	402
Acute Myocardial Infarction	410
Angina Pectoris	413
Other acute ischemic HD	411
Miscellaneous ischemic HD	412, 414
Pulmonary embolus	415.1
Heart failure	428
Stroke	434-436
Pneumonia	480, 486
Acute bronchitis	466
Chronic bronchitis and emphysema	490-492
Bronchoscopy	33.22, 33.23
Cholecystectomy	51.2
Unilateral inguinal hernia repair	53.0
Bilateral inguinal hernia repair	53.1
Cystoscopy	55.21, 55.22, 56.31, 57.32, 58.22
TURP	60.2
TAH	68.3, 68.4
Vaginal hysterectomy	68.5
Total hip replacement	81.5
Arthroplasty, knee	81.41, 81.47

Table 3

Conditions Subject to Recent and Significant Innovation, for Which Innovation is Expected to Affect Physician Practice Pattern

Condition	Innovation	Effect
Pschemic Coronary Disease	New Antianginals	$\Delta X_3, X_{3a}$
	PTCA	X_3, X_1
Acute Myocardial infarction	IV streptokinase	x_1
Congestive heart failure	New alterload reduce	DX_{3a}, X_3
New inotropes	uncertain	
Heart transplant	uncertain	

CONDITION LESS SUBJECT TO....

Condition
Pneumonia
COPD/Bronchitis
Cystitis/Pyelo
BPH/TURP
Stroke

Table 4

Percentage of Adult Patients who Should have Attendances For Diagnostic Evaluation, Treatment, and/or Follow-Up with Primary Care Internists as Hospital Inpatient (In First Year)

(from Schonfeld V2 Table 10)

Condition	Percent	Reference
Pulmonary Embolism	100	Schonfeld, H.K., Heston, J.F., and Falk, I.S. *Standards for Good Medical Care* USDHEW 1975
Acute Myeloid Leukemia	100	
Bacterial Meningitis	100	
Myocardial Infarction	100	
Cerebrovascular Accident	860	
Multiple Sclerosis	66.7	
Bacterial Pneumonia	54.2	
Intervertebral Disc Hernia	35.0	
Congestive Heart Failure	27.1	
Diverticulitis of Colon	27.0	
Pulmonary Tuberculosis	18.8	
Pyelonephritis	16.7	
Parkinsons Syndrome	15.7	
Labyrinthitis	10.0	
Hiatal Hernia	7.8	
Angina Pectoris	4.9	
Diabetes Mellitus	4.9	
Influenza	4.0	
Acute Grondutis	3.3	
Urinary Tract Infection	1.0	
Viral Gastroenteritis	0.5	
Hemorrhoids	0.0	

Table 5

Surgical Procedures for Which Zero Less than P_{ia} Less than One

- Excision malignant lesian, skin (basal cell, melanoma)
- Breast biopsy, incisional or excisional
- Pilonidal cyst excision, simple or extensive
- Gynecomastia excision
- Synovectomy, shoulder, elbow, forearm, wrist, etc.
- Arthroscopy, knee
- Arthroplasty, elbow, hand and fingers
- Bronchoscopy
- Laryngoscopy
- Temporal artery ligation or biopsy
- Varicose vein ligation
- Esophagoscopy/gastroscopy
- Percutaneous liver biopsy
- Inguinal lerniorrhaphy
- Transurethral resection of bladder tumor
- Prostate biopsy
- Orchiectomy
- Dilation and currettage
- Cataract extraction
- Ocular enucleation
- Iredectomy
- Myringotomy

Table 6

Distribution of Conditions Among Aftercare Facilities

Rank and Ratio of Post-Hospital Admission in DRG to Total Admissions HHA and SNF, and Hospital Bills

DRG No.	TITLE	HHA Admissions[1] Percent (Rank)	SNF Admissions[1] Percent (Rank)
14	Cerebrovascular Disorders Except: TIA	4.8 (2)	9.9 (1)
88	Chronic Obstructive Pulmonary Disease	3.0 (6)	1.7 (14)
89	Simple Pneumonia and Pleurisy > 69 w/ or w/o Complications	2.0 (9)	3.5 (4)
122	Circulatory Disorders w/AMI, w/o Cardiovascular Complications/Alive	2.0 (10)	1.1 (22)
127	Heart Failure and Shock	5.2 (1)	3.8 (3)
132	Atherosclerosis > 69 and/or Complicating Conditions (C.C.)	3.4 (4)	2.8 (7)
182	Esophagitis, Gastroentestinal, misc. digestive > 69 and/or C.C.	2.4 (8)	1.7 (13)
209 surg.	Major Joint and Limb Reattachment	1.9 (11)	3.2 (6)
210 surg.	Hip and femur Procedures Except Major Joint > 69 and/or C.C.	1.6 (12)	5.5 (2)
233 surg.	Other Musculoskeletal and Connecting Tissue O.R. Procedure > 69 and/or c.c.	1.2 (22)	3.4 (5)
236	Fractures of Hip and Pelvis	1.1 (27)	2.7 (10)
294	Diabetes > 36	3.2 (5)	1.6 (17)
296	Nutritional and other Metabolic Disorders > 69 and/or C.C.	1.5 (16)	2.2 (11)
320	Kidney and Urinary Tract Infections > 69 and/or C.C.	1.5 (14)	1.9 (12)
468	Unrelated O.R. Procedure	2.7 (7)	2.7 (9)
470	Ungroupable	3.5 (3)	2.7 (8)

[1] The Rand Corporation (prior to end of 1982).

[2] HCFA, BDMS, OSDM (1984)

Table 7

Variations in Post Hospital Care Utilization rates by Location for Selected DRGs: 1981 (Table 6 30 ? source)

Condition	(DRG)	HHA: Percent Discharged To	SNF: Percent Discharged To
Cerebrovasc. accident	014	18.4	13.2
Other hip and femur	210	25.3	30.2
Pneumonia	89	19.1	5.2
Heart failure & shock	127	13.6	3.4
Major joint	209	24.6	14.4
Misc. metabolic	296	14.4	7.4
Kidney and urinary tract infections, dx 2	320	13.8	5.9
Esoph., gastroent. and misc. digestive disease, dx 2	182	6.5	1.6
TIA	015	9.7	3.0
Fracture of hip, pelvis	236	16.3	17.2
Unrelated or procedural problems	468	12.2	4.2
Medical back	243	8.6	2.6
Chronic obstructive pulmonary disease	088	8.8	2.2
Diabetes ≥ 36	294	11.4	2.8
Major large/small bowel procedure, dx 2	148	19.7	4.9
AMI, discharged alive	122	9.8	1.9
Respiratory neopl.	082	12.7	2.9

Table 8

LOS, Rel Weight as Index for Ancillary Service Use, Selected Conditions (by DRG)

DRG	Title	Relative Weight	Mean LOS
014	Specific (VD except TIA (Stroke)	1.314	12.6
015	TIA	.624	6.1
039	Lens Procedures	.572	2.3
088	COPD	1.077	8.5
089	Simple Pneumonia > 69	1.177	9.6
096	Bronchitis + Asthmia > 69	.845	7.3
121	Circ. disorders with AMI & CU complic.	1.769	12.4
122	Circ. disorders with AMI & w/o CU complic.	1.327	10.6
127	Heart failure and shock	1.010	8.9
132	Atherosclerosis > 69	.804	7.0
140	Angina pectoris	.689	5.7
143	Chest pain	.589	4.5
161	Inguina and fem. hernia > 69	.653	5.3
209	Major joint	2.393	15.8
210	Hip and femur procure with major joint	2.032	16.9
336	TURP > 69	.987	7.9

From Federal Register 50: 35722-35736 9/3/85

Table 9

Condition	P(Adm)	P_{2a}	P_{3a}	X_{1a}	X_{2a}	X_{3a}	X_1	X_2	X_3
Pneumonia	.54	(.46)			-	+	+	+	+
CHF	.27	(.73)			+/-	+/-	+/++	+/++	+/++
Stroke	.86	(.14)			+/-	-	++	+++	+/-
Pulmonary embolism	1.0	0			-	-	++	++/+	++/+
AMI	1.0	0			-	-	++	+	++/+
THR	(1.0)	0			-	-	++	+++	++/-
IHR	(?)	-			-	+	+	+/-	+/-
DM	.049	.95			+/-	+	+	+/-	+
Angina pectoris	.049	.95			+/-	+	+	+/-	+

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